MARIELLO, FRANCES. A Comparison of the Effect of Ordered and Scrambled Sequential Techniques in Programed Tennis Rules for Beginning Classes. (1968) Directed by: Dr. Gail M. Hennis. pp. 171

The purpose of this study was to test the effectiveness of ordered and scrambled sequential presentations in the programed instruction of tennis rules. A secondary purpose was to observe the effectiveness of programed instruction as the source of information among college students engaged in the study of tennis rules. The linear program was constructed with a horizontal ordered sequence and a vertical scrambled sequence. The constructed program proved to be valid according to the standard of the American Institute for Research. Selected students in four beginning tennis classes were used as the subjects in this study. They were divided into matched pairs on the basis of a tennis rules pre-test. One group studied the programed manuals according to an ordered sequence while the second group studied the material in a scrambled sequence. The subjects completed the programed manual on tennis rules in one week and were then post-tested on tennis rules.

Within the limitations of this study the results indicated that the constructed program was an effective method of learning tennis rules; that neither method of sequencing was more effective in relation to learning; that the ordered sequence required significantly less time to complete than the scrambled sequence; that the ordered sequence produced significantly fewer program errors; and

that programed instruction of tennis rules could eliminate the necessity of initial teaching of tennis rules in the regular class situation.

A COMPARISON OF THE EFFECT OF ORDERED AND SCRAMBLED SEQUENTIAL TECHNIQUES IN PROGRAMED TENNIS RULES FOR BEGINNING CLASSES

by

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CHAPTER I

INTRODUCTION AND STATEMENT OF PROBLEM

The advent and use of programed instruction has enabled educators to discover more about the learning process and subsequently, how to teach more effectively. Programed instruction is not an aid to learning but is itself a process, a systemic approach to the complex behavior called learning. As such, programed instruction has developed as the first instructional technology in education. It is a method that can successfully simulate the interaction between teacher and student and also allow for the active participation of the student in the learning process.

The principles of programed instruction implemented through teaching machines has placed the responsibility for student learning upon the program and the instructional technology involved. This shift in responsibility has occurred because of the very nature of programed instruction. Instructional material must be programed in some manner to be used in teaching machines and in order to program materials, the instructor must scrutinize the material to be presented. This means that clearly stated objectives must be formulated and acceptable learning behavior must be determined. When these steps have been taken and the

program has been written, the next step is to test the program on the students. If the students do not learn, the fault lies within the program which must be revised and reworked until it actually teaches. This entire process necessitates a re-evaluation of the learning process. Through constant re-evaluation, programed instruction attempts to insure learning for as many students as possible. (15)

Many diverse programing techniques are presently being used to achieve optimal learning. These programing techniques vary in many technical aspects but there are certain characteristics which remain constant in all programing.

1) The material is presented in small steps called frames.
2) There is an active responding on the part of the learner as he continually interacts with the program by responding to each frame.
3) There is an immediate feedback of information to the learner concerning his response.
4) The program is self-pacing as the rate of progress is individually determined by the speed with which the student can complete the program. (27, 32)

The manner in which these characteristics are presented can, and does, vary but they are never overlooked.

The writer believes that programed instruction can be utilized effectively within the field of physical education.

Much class time is currently spent learning materials which, if effectively programed, could be learned outside the class situation. If the time spent presenting and learning rules were eliminated, more class time would be available for the acquisition of specific skills. (8) Tennis is a sport that can be included in the group of activities in which valuable class time is spent learning the rules of the game. Granted, it is essential to know the rules in order to play a meaningful game; yet, perhaps, the necessity of using class time for this purpose is out-dated. The prospect of learning game rules effectively outside class time deserves investigation for several reasons:

1) Rules are highly structured, factual knowledge that lend themselves well to programing.
2) Research indicates that learning through programed instruction is highly effective. (19, 22, 41, 48, 51)
3) The self pacing aspect of programed instruction should aid all the students in acquiring a better understanding of the rules.
4) The amount of time which could be spent on other aspects of learning in this class time is enticing.

With these points in mind, the purpose of this study was to test the effectiveness of ordered and scrambled sequential presentations in the programed instruction of tennis rules. The program to be tested was designed for use in beginning tennis classes on the college level. A secondary purpose of

the study was to observe the effectiveness of programed instruction as the total source of information among college students engaged in the study of tennis rules.

Definition of Terminology

Within the area of programed instruction there are many terms which have varying interpretations. The following meanings were accepted as the relevant terms applicable to this study.

Programed Instruction* - Instruction that is characterized by controlled material presentation, appropriate student response, guidance of the subject matter, and the control of the learning process. (8)

Programing - The process of arranging the program content into sequential steps; the arrangement is usually from familiar background into the more complex concepts. (8)

Frame - A single segment of the material with which the student deals at one time. (29)

Stimulus - That part of the program that elicits a student response; the information within the frame. (8)

Response, Constructed - A response that involves writing, verbalizing, or mentally constructing a response

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*The field of programed instruction is full of conflicting opinions. There is no agreement even as to the spelling of the term. Some prefer "programming" while others adhere to "programing". The author has selected the latter spelling.

rather than a selecting from a set of alternative responses. (31)

Feedback - A report to the student on the status of his response. (8)

Panel - A section of material available to the student while he works through a series of frames. (29)

Prompt - An added stimulus to facilitate the appropriate response from the student. (29)

Reinforcement, Immediate - Providing the student with immediate feedback regarding the success or failure of the response. (8)

Terminal Behavior - The behavior of the student that is expected to be acquired at the end of the program. (29)

Forced Frame - A frame which gives the student no obvious information, but forces him to respond correctly. (27)

Copying Frame - A frame in which the grammar is an instruction to copy one or more words. (29)

Ordered Sequence - The manner of sequencing a program in which the successive frames present hierarchial information.

Scrambled Sequence - The manner of sequencing a program in which the successive frames do not present hierarchial information.

CHAPTER II

REVIEW OF LITERATURE

The task of education is to have the learner exhibit appropriate behavior that is conveyed through subject matter. (36) Whether written, oral, or performing, it is through behavioral change that learning is determined. This has been aptly stated by Mager.

> Since we cannot see into another's mind to determine what he knows, we can only determine the state of his intellect or skill by observing some aspect of his behavior or performance. (28:13)

This change in behavior involves individual response to a stimulus situation with the subject matter serving as the stimuli. When a response occurs with increased frequency in a repeated situation, there is learning. (9) Programed instruction is concerned with how this learning occurs.

Learning Process

Green has labeled the process by which change in behavior or learning is accomplished as response differentiation. (18:113) Learning is an individualistic process necessitating provision for each student's repertory of responses which must be refined to the desired responses. For this response differentiation to take place, it is necessary to provide the proper learning environment. The

essential elements for this environment include an environmental stimulation of the student and incentives that will, when obtained, lead to the satisfaction of the motives. (1) In accordance with this concept, programed instruction is a particular form of ordering stimulus and response events in an attempt to effect a behavior change.

Gagné refers to this as productive learning. (44) There are two categories of variables within productive learning: knowledge and instructions. The knowledge is the capabilities that an individual possesses at any given time of the learning. This initial knowledge level is developed through a hierarchy of subordinate knowledges which combine to support the final learning task. It is necessary for these subordinate knowledges to become part of the individual's response pattern in order to accomplish the final task.

The instructions within productive learning generally are in the form of sentences which communicate something to the learner. The elements of the stimulus situation and the required terminal performance are identified through the instructions. The recallability of the learning sets are established through repetition within the instructions. The instructions also help promote the application of these subordinate learnings to the performance of a new task. The specific transfer from one learning set to the next in the hierarchy is dependent upon the recall of the previous learning sets and the effect of the instructions. The

transfer will be zero if there is no transfer and will range up to 100% if the necessary material can be recalled. Thus the degree of specific transfer is inherent within the structuring of the learning process.

The behavioral change that is brought about by this specific transfer within the programed learning situation is referred to as a new capability. Another term is necessary in order to identify that behavior change which is acquired through correct response in the programed learning situation. Gagné states that knowledge is an acceptable term as knowledge is, by definition ". . . that inferred capability that makes possible the successful performance of a class of tasks that could not be performed before the learning was undertaken." (44:355) The process of acquiring this capability is enhanced by a strengthening of the desired behavior which is reinforcement. (14) This is accomplished through a feedback of information to the learner. According to Stolurow, feedback is the means by which the learning process is brought under stimulus control. This information feedback serves as many as four purposes. It may cause a shift in attention or in subject-matter cues. This feedback of information may change the learner's motivation or act as a reinforcer. These four functions occur in differing intensities whenever feedback takes place. The intensity of each variable is dependent upon the situation. Ideally, these are positively correlated, and stimulus events following

one response will elicit other responses. In relation to programed instruction, feedback initiates a response which is reinforced and in turn shifts the attention of the learner to the next cue or source of information while changing his motivational level. (67)

The function of feedback which is most important to programed learning is that of being a reinforcer. Green defines reinforcement as ". . . the result of a physical event acting upon the organism; the effect upon the organism is an alteration in its behavioral topology." (18:41) As such, reinforcement is one of the basic elements dictating a behavioral change. The reinforcement pattern that is established through programed learning is referred to as the schedule of reinforcement.

Reinforcement

It has been stated that the time lapse between response and reinforcement determines the speed of learning. The less lapse there is, the more rapidly will learning occur. (6, 8, 36) Perin, reporting in a laboratory study with white rats, stated that when reinforcement was delayed longer than thirty seconds, the correct response would not be learned. (55) In a study with elementary school children, Porter recommended reinforcement that is immediate, relevant and repeated. (67) Krumboltz cites studies involving programed texts, group discussion, and Chinese symbols

which found immediate reinforcement superior to delayed. (50)

In one of his first papers on programed learning Skinner stated:

> It can be demonstrated that unless explicit mediating behavior has been set up, the lapse of only a few seconds between response and reinforcement destroys most of the effect. (34:24)

The type of reinforcement suggested by these studies is known as continuous reinforcement. Such reinforcement is impractical, if not impossible, for the traditional classroom teacher as reinforcing each response by every student cannot be accomplished in the traditional manner. Moreover, the problem is amplified by the interaction itself.

> The reinforcement that one derives from the behavior of another organism is no more reliable than the behavior of that organism. The one thing certain about the behavior of organisms is that to a degree it is uncertain. (18:113)

Yet the need for continuous reinforcement is a definite one. The learner chooses the response he thinks is most likely to satisfy his wants. If his response is positively reinforced, he will make a similar response the next time this type of situation occurs. Through this reinforcement, the learner engages in response discrimination. If the response is reinforced, it becomes a conditioned or learned response. (9) Skinner asserts that only by analyzing the effects of reinforcement and then designing techniques which can manipulate reinforcement will the behavior of an individual be controlled. (34) Research in the area of reinforcement and

discrimination learning has been conducted for many years. However, it has been done largely by experimental psychologists working with animals. Consequently there exists a chasm between the findings in the laboratory and practical application to education. Many reasons have been given for this condition. Experimental psychologists have tended to avoid the practical problems of education and teachers have not been concerned with the literature and research of the psychologists. Educators could see little relationship between the study of the learning process, animal behavior, and the classroom situation. On the other hand, in laboratory work with animals, the experimenter is concerned with use of the animal after it has been conditioned to emit a particular response. There is virtually no literature available concerning the initial conditioning procedures. This missing information is what the educator needs. (18)

Skinner claims that the modern classroom offers little to suggest that even the available research in the field of learning is respected or utilized. He further states that this condition has been enhanced by the hasty conclusion that laboratory study is limited because it cannot establish the realities of the classroom. (34) Although the laboratory work has been concentrated on lower organisms, the emphasis of the research has been on discovering and controlling variables of which learning is a function. This information can be utilized in teaching effectively. Yet,

as in the laboratory situation, some device is needed to arrange reinforcement for optimal learning if each learner is to have individual attention. (35) When Skinner's first influential paper was published in 1954, it included the still appropriate statement:

> Education is perhaps the most important branch of scientific technology. It affects the lives of us all. We can no longer allow the extingencies of a practical situation to suppress the tremendous improvements which are within our reach. The practical situation must be changed. (34:248)

Development of Programed Instruction

Programed instruction is the first application of the laboratory work of the psychologists to the practical problems of education. Programing was first employed in a class situation by B. F. Skinner in 1957. This was done at Harvard in a course which was designed to teach the behavioral principles that form the basis for programed instruction. The first prolonged use of programed instruction was done by Porter under the sponsorship of the Office of Education in 1960 when he conducted a year long experiment involving the teaching of spelling to sixth graders. Programed instruction was first used in the secondary school in 1959 when Eigen and Komoski conducted an experiment in teaching mathematics to seventy-four ninth and tenth graders at the Collegiate School in New York City. (19) Since this beginning, much research, revision, and re-evaluation has been done in the field of programed instruction.

In an attempt to explain the communication of programed instruction, the Socratic method has often been used as an analogy. (70) As in the Socratic method the student of programed instruction is led to new knowledges and skills by answering questions. In this manner, the learner is transformed from a passive receiver of information to an active participant in the learning process. (70) Jordan, however, claims that this is not a valid analogy. He bases his claim on the fact that Socrates was not a teacher, he was an inquirer. Socrates developed his method in an attempt to inquire into the use of language and the relationship between language and reality. Socrates used his method to ascertain what people knew about ". . . the true nature of things." (47:102) Jordan suggests that it is possible to learn from the Socratic method but the learning of correct responses is far from the actual implementation of the Socratic method. (47)

Perhaps the best parallel of the Socratic method and programed learning is the constant interchange between the student and the program. This does enable the student to become actively involved in learning. The necessity to understand a given point within the program before advancing may be compared with the necessity to establish an initial definition within the Socratic method in order to converse. The dichotomy appears when considering the fact that programing leads the learner to the correct response. The

program does help the student come up with the right answer and then provides reinforcement for every correct response. (47, 70)

Learning Theories and Programing Instruction

When beginning to structure an actual program, an attempt is made to utilize the information about the psychology of learning. Hilgard lists six principles of the psychology of learning that are provided for through programed learning. It recognizes individual differences, provides immediate knowledge of results, and requires that the learner be actively involved. An organized nature of knowledge is emphasized, spaced review is provided, and the learner knows that he is learning. (46) The programer is concerned with the behavior of learning and, therefore, structures his program in accordance with his assumption of how learning occurs. Some believe that the learner is a receptive organism whose associative connections are formed in a manner which mirrors experience. Advocates of this assumption believe that freedom of response should be controlled in programed instruction. The correct responses by the learner are dependent upon the ability of the program to elicit their formation from the learner's responsive system. The advocates of this theory think that minimizing error and incorrect responses on the part of the learner is essential. The type of program utilized by this group is one which has

been constructed to eliminate most error of response and does not necessarily provide for selective learning. This type of program is called linear.

Another group believe that the learner is a selecting and self-organizing mechanism who selects and extracts information from the environment. This group believes in a greater freedom of response for the learner than the linear programers. A branching or selective program which is not concerned with the formation of incorrect associations is used rather than the linear type. (70) Most of the materials that are being used in programed instruction have come from these two programing groups.

Regardless of the learning theory advocated, one essential element for any learning situation is that the student must have a sense of the importance of learning. He knows that as he learns to do more things, he is able to control more and more of his physical environment. The success achieved by this environmental control is a necessary characteristic of reinforcement. If the child learns that learning extends this control to him, learning will become important. This can be achieved through programed instruction because the programer selects the stimulus elements. Stimulus elements are those particular properties of the stimulus environment which form the basis for discrimination. In programed material, the stimulus elements are the information within the frames. The programer is responsible

for the formation of the learning environment with its stimuli, feedback and discrimination. (18) His utilization of the laboratory work of the experimental psychologists will enhance the success of his program. Individual instruction at individual rates with individual reinforcement is possible through proper structuring of the learning environment.

Teaching Machines

A teaching machine is defined as ". . . a mechanism that presents information to a student and controls his behavior in a predetermined interacting relationship." (70:5) There are three elements which compose a teaching machine. Any device, mechanical or manual, which has the criteria is classified as a teaching machine. If the material is presented in an organized, logical sequence which requires a response and provides feedback, the criteria are met. (18) Green has aptly stated the case for the teaching machine with the statement:

> The teaching machine is not simply another audio-visual aid. It represents the first practical application of laboratory techniques to education. The task of programed instruction--as of all instruction--involves the conditioning of a behavioral repertory. We seek to increase the behavioral repertory of the student. We seek to establish a complex class of behaviors and to bring that class of behaviors under the control of particular features of the environment. (18:122)

The idea of teaching machines is not a new one. Research into the history of teaching machines verifies the

fact of their lengthy existence. There are however, conflicting reports as to the dates of the first teaching machine. A patent was issued in 1866, for a spelling machine that was supposed to aid the teacher. A logic machine was developed around 1873. H. B. English invented a device in 1918 to help soldiers learn to squeeze rather than jerk a rifle trigger. (6) Green states that patents were issued as early as 1809 for devices aimed at aiding teaching. (18) Teaching machines have been in existence for many years and they have sometimes obscured the more important facets of the new technology which are based on an application of principles from the laboratory. Holland states that adequate machines could have been built hundreds of years ago. The upsurge today is in the development of a new technology--a behavioral engineering of teaching procedures. (20)

Skinnerian Programing

The present interest in programed instruction and teaching machines is attributed to the work and writing of B. F. Skinner. His needed transition from laboratory research to practical educational application has given a systematic basis for further research. The language and technology of Skinner's laboratory provide the framework for most published programed materials. (36)

Skinner was the first to give serious thought to the

actual programing of material. His original work with the learning process was of the laboratory nature and his concept of programing is based upon reinforcement. This is coupled with the belief that the learner is a receptive mechanism which responds to stimuli within the learning environment. Thus any stimulus that will make the correct response probable is acceptable. Skinner advocates the use of small steps within the program so that the learner will not be faced with more than he can successfully complete. Reinforcement follows each step and it is the responsibility of the programer to provide stimuli which will elicit the correct responses. The type of program Skinner developed is the linear program. (70)

The learning path in this program type consists of carefully sequenced frames for which the learner must construct a response. Each response is either confirmed or corrected before the learner continues. The linear program attempts to produce specific forms of behavior which are brought under control of specific stimuli through differential reinforcement. Prompts or cues are utilized to help minimize the probability of incorrect responses. By a gradual fading of these prompts, by a process known as extinction, the learner is led to the desired behavior. (45)

Skinner, in defense of the linear program, states that the learner needs to compose his response rather than merely selecting one from a suggested group. By composing

responses, the learner is able to recall information rather than merely to recognize it. He also states that the multiple-choice arrangement of the branching program must, of necessity, contain plausible incorrect answers. He considers these out of place when attempting to structure behavior as the incorrect suggestions strengthen unwanted behavior. (35)

Intrinsic Programing

Norman Crowder has also done much work in programed instruction but with a different assumption about learning. He is among the group that believe the learner is a selective organism who extracts information from the environment. The branching format which Crowder uses presents the material in a multiple-choice arrangement. The student is presented the information in paragraph form and then tested on each paragraph independently. The test result determines which section of material the student will see next. This type of programing is known as intrinsic and the term ". . . refers to the fact that the necessary program of alternatives is built into the material itself in such a way that no external programing device is needed." (10:290) The learner must select the most appropriate response from the ones listed and each possible answer leads to another section of the program. A wrong answer leads the learner to additional information in order to correct his error and

then may return him to that portion of the program so he may choose again. (70)

Crowder defends intrinsic programing with the rationale that learning occurs during the exposure of the student to the new material on each page of the program. The selection of the multiple-choice response to determine what materials the student sees next is based upon certain assumptions about learning. Crowder states that learning takes place in a variety of ways that vary with the ability and present knowledge of each student, the type of material within the program and other probable variations that are unknown to us. Intrinsic programing requires the student to respond to the material and then modifies the behavior in terms of the material to be presented next. This feedback control is the basis for this type of programing. Unlike the Skinnerian program, the primary purpose of feedback is not to provide the student with knowledge of results. The test result is used to determine the success of the communication and correct through more material if it was not successful. (10)

Both Skinner and Crowder believe that teaching must become more effective and that this must be done on an individual basis. They believe that the student must be actively engaged in the learning process and that immediate reinforcement is necessary. (66)

Some research has been done in an attempt to ascertain

which, if either program format is the more effective. The research is not extensive and the variability of the research procedures makes it unwise to conclude in favor of either format. Gilbert raises an interesting point which needs to be considered when interpreting such findings. He suggests that the behaviors open to the student using the multiple-choice format are several. The learner could read each suggested response carefully judging right or wrong as he reads it. When the student reaches an answer he judges right, he may stop or he may read on, leaving an option to change his response. He may read all answers and then select one. He may glance over the selected responses in search of an easy clue. He may read all responses suggested and then select one. He may make a wild guess. Conceivably he may read the problem, construct a response in his mind and then search the given responses to find one near his constructed response. In the latter case, the actual process of completing the program strongly resembles the linear type. Due to these many uncontrolled variables, any conclusions drawn from research findings contrasting the effectiveness of the two formats could easily be erroneous. (16)

Pressey and Teaching Machines

A name that is associated with teaching machines is that of Pressey. He is credited with being the first to give serious consideration to the widespread use of teaching

devices in the classroom. However, his main concern was the devices themselves and not the actual programing of learning. (6) The objective test gave Pressey the idea of using a mechanical device to administer and score tests. He also saw the possibility of this device to take over drill and recitation duties of the teacher if it were possible to give the student immediate information concerning the correctness of answers. (56) In 1927, he presented a paper on such a device. (57) Pressey continued his experimental work with teaching machines until the early 1930's. At this time, he presented another article expressing bitter disappointment with educational tradition. He stated that education needed an industrial revolution which would utilize quantity production methods and regretfully discontinued his work with teaching machines at this time. (58)

Pressey believed that teaching machines should supplement textbooks. Therefore, his materials placed little demand on the programer to make the program a self-contained unit. He stressed broad general questions and was not concerned with error in response. The text initiated learning and the program guided the learning. Consequently, any error meant that the learner should reread the text. (70) He was the first to emphasize the importance of feedback and his machines allowed the learner to take an active role in the learning process. (56) Pressey's early work laid the foundation for Skinner's revival of teaching machines. Feedback

and the active role of the learner are still two of the most important considerations in programed learning.

The influence of Pressey's work has been strongest in the military and industry. Perhaps this is because these two institutions are concerned with the construction of testing and teaching devices while education is more concerned with the actual learning situation. (18)

Reactions to Programed Learning

The impact of teaching machines and programed learning on education has produced numerous opinions, evaluation, and charges. Deterline states the situation in a concise manner:

> If the sign of protests against an idea and the intensity of the enthusiasm for that idea are valid criteria for the importance of an issue, then the subject of teaching machines is one of the most important current topics in education. (11:1)

Charges are laid that programed instruction only overtly provides for individual differences. It is charged that the only difference is in the speed of program completion, step size or the number of steps as the same program is used for all students and the material is covered in the same manner. It is stated that programed instruction eliminates the possibility of pupil participation in goal setting because the programer has predetermined all goals. It is also charged that programed instruction cannot deal with unexpected circumstances for any situation which has not

been provided for within the structuring of the program. (37)

Concerning individual differences and the necessity to alter the material presentation for various ability groups, research reports conflicting findings. Ferster and Sapon (43) taught German to Harvard graduate students and found little relationship. Lewis and Gregson (53) cite research which supports this view. Reed and Hayman (60) used three ability groups and found that the low achievement group did perform as well as the control group while the high achievement group did much better. No significant difference was found between the average achievers. A positive relationship has been reported in other studies. (64, 68) Research in this area is not sufficient to warrant a sound rebuttal to the charges. Stolurow has stated that until new information is available, there seems to be no need to prepare special programs for learners with differing general intelligence, providing that this intelligence is above the minimum level required for the learning task. (50)

Program Effectiveness

Research concerning the effectiveness of programed instruction shows a positive trend. Owen and others (54) found in a comparison with lectures that the programed material produced results equal to the carefully prepared lectures. They also suggested that the program was probably

more beneficial for poor students and those whose native tongue was not English. In his work with modern languages, Dungworth suggested that programed instruction can help overcome difficulties in teaching. He stated that in the traditional method, there was lack of overall teaching time and concentration of time to complete instruction. The program alleviated these problems and also helped to motivate the student. (41) Homme and Glaser reported a study comparing groups using programed texts and regular texts. Two different subject areas were used. In both cases the programed students outperformed the standard sections on achievement tests. (6) Studies have also shown that programed instruction can be used successfully at the elementary school level. (6, 48, 68)

This survey of available research indicates that teaching machines are effective for a variety of subjects and different groups of learners. Although the volume of the research is increasing, the results are more provocative than definitive. (70) Until some standardized experimental designs can be used with more controlled variables, the results will not be definitive. Rothkopf concludes a study with college students emphasizing the variability within research to date.

> The effectiveness of any given self-instructional program depends largely on the craft of the individual programer and the amount of empirical work which is devoted to the development of the program. (64:27)

Machines or Texts

Assuming that teaching machines are beneficial educational innovations, the next question is whether the actual machine is superior to the programed text. In both cases, the media is merely a device for the presentation of materials. The learning occurs through the interaction of the student and the material. (18) There is criticism of both methods of presentation. It is stated that the machines are unreliable because they break down. Machines are also criticised because they are not standardized and a program that fits in one machine may not fit in another. Perhaps the greatest criticism is that the devices may dictate the type of programs to be used. Rather than designing a program to fit the learner, it may be designed to fit the machine. An argument against the text is that it is possible for the student to go back and forth through the material. If more than one frame is presented on a single page, the student may scan these and be tempted to answer ahead of his actual place in the program. With these charges, it is argued that the machines potentially have more adequate control over the sequence of the learning process. (18) Goldstein and Gotkin reviewed eight experiments comparing machines and texts and found appreciable learning difference between them. These studies were conducted on the elementary, secondary, college, and technical trainee levels. In four out of five studies in which program completion time was a variable, a

significant difference was found in favor of the programed text. (45) A study utilizing an algebra program reported that the data did not support the claim that the student is benefited in terms of post-test performance or time taken to complete the program when using a teaching machine. (61) In a review of research studies to ascertain if learning from the machine is superior to that from programed texts, it was found that there was no significant difference in mastery by either manner of presentation. The general finding was that the material was completed quicker with the text. (45) Perhaps the influencing factor in relation to wide spread adoption of either method in the school setting will not be from laboratory finding but of an economic nature. The limitations of school budgets would curtail any extensive buying of the machines.

Program Paradigm

The selection of a program paradigm is the last step before the program is actually developed. It supplies the conceptual basis through which the individual items are connected. It must be chosen in accordance with the programer's assumptions about learners, and the objectives of the program. The two principle paradigms are the linear and the branching forms. They represent the extremes and there are various combinations between them.

Many studies have been reported in an effort to test

the effectiveness of the two paradigms. Coulson and Silberman found the constructed response of the linear program superior to the multiple-choice format only when the nonbranching program was used. Fry obtained the same type of results using immediate and delayed tests while holding the learning time constant for both groups. Roe found no significant learning difference using the two methods. (62) Evans, Glaser and Homme concurred. (50) Larkin and Leith reported that bright ten year olds learned equally well from each program. They also found that the children of lower ability scored better after using the linear program. (51) Their results may be due to the sequential ordering of small steps which characterizes the linear program. Coulson and Silberman found in a study with junior college students that the linear program group had a higher mean score on the constructed response test. There was no difference between the groups on the multiple choice test. (39) Williams suggested a combination of response modes by using the constructed response training on technical items and multiple-choice training on items with a familiar vocabulary. She reported that this combination can be a successful programing technique which will increase post-test scores and provide a variety of responses within the program. (69) Kemp's research indicated that if the response format was unrelated to the post-test, the manner in which the learner responded was of little importance. If the learner was to be post-tested

on material which was a contingency for correct program responses, the response format was important. (49) In the actual selection of the paradigm to be used, the research indicated that learning was not significantly more effective in either mode. However, the choice of a paradigm greatly influences the program construction. The preparation of a program is also influenced by the use of an ordered sequential technique. The material is presented in a logical sequence in order to ensure effective learning. This principle of programing is reflective of the Skinnerian approach and is still widely accepted. Carr also emphasized the importance of carefully preparing the sequential order for effective learning. (16)

In deference to this, a study was conducted by Roe in which he suggested that college age students did not require careful selection for sequence of items to learn effectively. Roe used a program of seventy-one frames and administered the criterion test immediately upon completion of the program. His subjects were thirty-six freshmen psychology students. The results showed no significant mean score difference between ordered and random item sequences. (63) Levin and Baker conducted an item sequence study on the elementary school level and found no evidence that item scrambling impaired learning. The program used contained 180 frames and produced a significant amount of learning. However, it did not teach mastery of the material, as indicated

by the post-test scores. It was suggested that a more effective program would have been made less effective when scrambled. (52) Thelen also reported that experiments demonstrated that students learned as much when the program was presented in a random order as when it was in proper sequential order. (37)

In a study conducted with 189 freshmen enrolled in an engineering laboratory course, Roe found that the group with the scrambled sequence performed significantly worse on learning time, errors during learning and post-test scores. (62) Although the research in this area was not conclusive, it was intriguing and worthy of further inquiry.

Because of the assumption that learning is more effective when provided in a sequential order, programers spend a great amount of time preparing programs in an organized, sequential pattern. If learning was as effective without the strict sequential order, much time could be eliminated from the programing process. This would mean a shorter preparation time and one that was not quite as meticulous. More programs could be constructed in a shorter time and perhaps more instructors would be able to program successfully. This could greatly influence the range of use of programed instruction.

Application of Programed Instruction

Programed instruction has been utilized to the

greatest extent outside the formal educational structure. Industry and governmental agencies used programed materials extensively. In a survey completed in 1963, it was reported that 382 different programs were being used in actual training operations by 125 governmental agencies. The program length varied from one to 150 hours with six hours as the median. Eighty-eight percent of these programs were produced by in-house programers. This was partially due to the non-availability of commercially produced programs in these areas. Most of the programs were being used in the classroom situation. (4)

The armed forces have also incorporated programed instruction into their training programs. Davies stated that programing has become part of the official policies of the United States Air Force. He reported that their question is not whether the technique worked but how to utilize it effectively and economically in training. (40) The Royal Canadian Air Force reported that effective learning has been achieved with programed instruction both with and without teacher assistance. With programed instruction training losses have been reduced considerably. (42) The United States Navy used programed instruction for seamen in the maintainence and operation of shipboard missles. These were just a few of the many reported uses of programed materials within the armed forces. Through this wide usage, it was found that programed instruction could accelerate initial

training. It could permit training and retraining on a non-scheduled basis and in remote-site bases. Programed instruction not only relieved the instructor for advanced and supplementary duties but also relieved the critical shortage of qualified instructors. Programed instruction also allowed for a standardization of technical instructional materials. (30)

The advocates of programed instruction in industry are becoming more numerous each year. In 1960, very few programs were in use. By the spring of 1963, of the 237 companies reportedly using programs, forty reported in-house capability for producing their own programs. The linear program was the most widely used and the trend was toward programed texts rather than the actual machines.

Programed instruction was used in industrial training as segments of initial and supplemental training. Only 5 per cent of the programs in use were reported to be total-job programs. There were many plausible reasons for this. The size of the trainee population may not have been large enough to warrant the expenditure of time and money. It was also possible that the time needed to develop the total-job program may have been longer than was desired. (33)

Research indicated that the programing being used in industry was quite successful. IBM conducted three experiments using the first fifteen hours of a training course for custom engineers. The comparison was between programed

texts and classroom instruction. Programing proved to save 27 per cent in time needed to present the material. The programed group showed a 10 per cent learning gain over the control group and had a smaller dispersion of scores. It was suggested that this possible learning improvement should produce more effective employees. (21)

In a study conducted by Stanford Research Institute, three groups of journeymen were taught the fundamentals of electricity. One group used programs; one was taught by teachers; the last was a combination of the former two. It was found that the combination was the most effective method. It was concluded that programed instruction was as good or better than traditional methods and the self-pacing aspect was beneficial to the slow learner. It was also suggested that teaching machines took the psychological risk factor out of adult education. (5)

The General Telephone Company of California reported that by using a taped program to train operators, there was a 40 per cent reduction in training time. This study also found a 52 per cent increase in passing scores and an 85 per cent increase in perfect scores. (3) Keyes reported that programed instruction produced a significant reduction in training time without the loss of training quality. (24) These studies reported typical findings for the use of programed material in industry.

Effective learning is an essential criterion of

performance yet there are other results to be obtained from programing that are particularly enticing to industry. Programed instruction offers a quality control of the material. What should be presented is presented. This is not always true for the traditional training class. Programs are tested before general use and they do satisfy the intended objectives of the training operation. The scheduling flexibility that is possible opens many alternatives. The program can be completed on an individual basis without scheduling classes, or time can be allotted during the work day. Training can be accomplished on a staggered basis and production will not be disrupted. The self-pacing allows the rapid learners to report to their jobs faster and the companies are more willing to allow slow learners more time to complete the program if they will achieve the desired proficiency level upon completion. (33) Holt and Valentine did a study in which they compared programed instruction with the lecture method in a basic electricity course. Immediate and delayed proficiency showed a significant difference in favor of the programed group although there was considerable variation in completion time for this group. The low aptitude trainees apparently benefited from the self-pacing as there was a greater spread of scores toward the low end of the distribution for the lecture taught low aptitude learners. (33)

The use of programed instruction in education has

been slow in evolving. In a study conducted in 1962 and 1963 by the Center for Programed Instruction to determine the use of programed materials in the schools, questionnaires were sent to over 14,000 school systems listed by the Office of Education. The largest single group of respondents was non-users although they expressed a familiarity with the terms programed instruction, programed learning and teaching machines. Most of the programs in use were commercially prepared although 17 per cent were programed locally. The school systems using programed instruction tended to be the larger systems. In both surveys, the mathematics programs were the most available and the most widely used. Most units were used on the secondary level although they had been used successfully on the elementary level. (19) Keisler reported a study involving the teaching of arithmetic to fourth and fifth graders in which the programed group scored considerably higher on the final examination than the control group. In Roanoke, Virginia, thirty-four fourth graders completed a two term algebra course in one term. They worked on the program for fifty minutes a day without teacher assistance and they were not assigned homework. Forty-one per cent scored higher on a final examination than the average of a group of ninth graders who completed the two term course. (22)

As reported in the survey, the students using the programed materials were generally considered average in

intelligence. Many administrators had intended to use the programs with remedial or advanced classes, yet actual usage favored regular instruction for both years. Over 70 per cent of the school systems using programed material did so without teaching machines. The point of Goldstein and Gotkin, as well as other researchers, is well taken considering the apparent effectiveness with either mode. There was an overall favorable reaction to the use of programed materials although many respondents felt that it was too early for an over-all evaluation. The scope of usage has increased yearly and the trend seems to be in that direction. (19)

Use of Programed Instruction in Physical Education

The actual use of programed instruction in physical education has been quite limited. Penman's book, Physical Education for College Students, was published in 1964. This text was meant for basic physical education classes and had a scrambled format. (31) Barnes' book programed for volleyball officials was published in 1965. This text was tested at three universities and the students using the text had higher mean and median scores on the volleyball officiating examination than the non-users. (2) Clayton recently published a programed text on physiology of exercises. Over 150 students were used to help construct the text. Most of these students scored 80 per cent or higher on the

examination Clayton used with the text. (7)

In a study of the effectiveness of programed instruction on knowledges and playing ability in badminton, Neuman reported that knowledge of rules could be learned effectively through programed instruction. She also reported that overall knowledge and playing ability were not increased through the program that was used. (71) The results of this study tend to support the view of Redd who suggests that the area with which physical educators can utilize programing is in the factual content of rules and highly structured material. (59)

Although the implementation of programed instruction within the field of physical education has begun slowly, the subject area is suitable for programing and the results seen so far indicate that this can be done successfully.

Summary

The review of literature for this study has indicated that programed instruction is based upon the work of the experimental psychologists, and the work of Pressey, Skinner and Crowder is fundamental to the development of programed instruction. Reinforcement and feedback are two of the most important provisions of programed learning and the linear and intrinsic methods were the main ones used in the research investigated. Although much research had been completed in an effort to ascertain whether the teaching machine

or the programed text is the more effective, the results of these studies reviewed were not conclusive. One of the principles of programed instruction that was being challenged was the necessity to present material in an ordered sequential manner. Roe, Levin and Baker have done work in this area.

It was determined that programed instruction lends itself well to highly structured material. It was also determined that game rules are highly structured material and that much class time is spent in the teaching of game rules. This class time could be used for other learning areas if the use of programed instruction were incorporated to teach the game rules.

CHAPTER III

PROCEDURE

The following sequence of procedures was employed in constructing and testing the effectiveness of ordered and scrambled sequential techniques in the programed learning of tennis rules. The program used in this study was designed for use in beginning tennis classes on the college level.

Subjects

Sixty-two students enrolled in beginning tennis classes at the University of North Carolina at Greensboro were used as subjects in this study. The number of correct responses on a tennis rules pre-test was used to divide the subjects into matched pairs. (See Appendix M). The subjects used in this study were enrolled in four beginning tennis classes during the spring semester of 1967-68. Two of the classes were taught in the morning and two in the afternoon. Each of the classes was taught by a different instructor. One of the subjects had previously worked with a programed text and thirteen said that they had some understanding of programed instruction. There was no reason to believe that these subjects deviated from the normal college population enrolled in beginning tennis classes at the University of North Carolina at Greensboro in any given semester.

Program Construction

After investigation into learning theories, the learning process and reported research in programed learning, this programer selected the linear paradigm. A unit on tennis rules involved skills which must be closely interrelated. The type of terminal behavior desired required constructed responses on the part of the learner. All subjects in this study were beginning tennis players with little knowledge of the rules. A rules pre-test enabled the programer to rule out any subjects who possessed the desired terminal behavior. Thus it was not necessary to provide a varied program to accommodate differing levels of background responses. The one characteristic of Skinner's linear paradigm that this programer tested was the accepted necessity of presenting the material in a sequential manner for effective learning.

The pre-determined material for the program content was divided into the following five sections:

I. Court Lines and Areas

II. Serving Rules

III. Scoring Rules

IV. Changing Sides of the Net

V. Doubles Game: Serving and Receiving Orders

The current DGWS Tennis Guide served as the source for the rules within each section. (12) After selection of the rules was made, a sequential order of presentation was

established. This pattern of presentation moved from the simple to the more complex concepts within each area. (See Appendix B). The sequential rules order was then used in the actual ordering of the frames.

Program Objectives

The objectives of the program fulfilled three purposes: (1) developing an ability of the subjects to apply the rules concepts to arbitrary situations (2) to enumerate what the students should know upon program completion (3) to guide the programer in the development of the program. (See Appendix A).

Frame Writing

The programer leaned heavily upon formal prompts throughout the entire program. Thus the student was provided with information concerning the structure of the correct response without its meaning. (30) The necessary relationships were developed after the proper terminology became familiar to the student. Forced frames were utilized to convey the simplest rules and copying frames were employed to aid in the learning of the material.

During the development of the program, three sophomore students were used to evaluate each independent section. One of the sophomores was a better than average student with little tennis experience. The remaining two sophomores were average students. One had no tennis

experience and the other had had considerable tennis experience. Each of these students evaluated each of the five sections independently. The frames were printed on three by five cards with the response on the back of the card. The students responded in written form to the program frames and were asked to comment whenever an incorrect response was made. The programer then questioned the student as to the reasoning behind the response she had chosen. The individual interpretations, constructive comments, and honest criticism proved helpful in initial frame revision.

Test Construction

The forty-four item written test was designed to be used as both a pre-test and a post-test. (23, 25) As a pre-test, it served as the equating factor in the matched pair selection. The post-program administration served as an objective evaluation of the subjects' knowledge of the program content. A comparison of the two administrations demonstrated any change in knowledge and consequently reflected the effectiveness of the program. A further comparison of the post-test results demonstrated the effectiveness of the two types of program sequencing.

The test items were constructed in accordance with the program objectives. Each test question was classified as belonging to one of the five sections of the program. A percentage of the total test questions was determined for

each section in this manner. This same procedure was used to determine the number and percentage of frames within each section of the program. (See Table I). Curricular validity of the test did not seem to be applicable with this program. The inconsistencies of the program and test item percentages were due to several factors. The difficulty of the concepts within each area of the program was variable as it took more frames to develop the more difficult concepts. The most important concept in tennis is the ability to keep score. In order to keep score the student must, of necessity, know the interrelationships of winning and losing points. Many of the rules covered in areas other than scoring within the program have a scoring implication when applied to a game situation. Consequently these questions were categorized with scoring on the test. It was for these reasons that the apparent disproportion in percentages seemed appropriate in this instance.

Pilot Study

In an attempt to discover the revisions necessary in the program and the test, a pilot study was conducted. Three students in a beginning tennis class which was not to be used in the actual study were used as subjects. The three were volunteers and fulfilled no criteria. The rationale of selection was to use subjects similar to the actual test population. It was apparent from the pre-test

TABLE I

CURRICULAR VALIDITY OF
KNOWLEDGE TEST

PROGRAM CHAPTERS	PROGRAM FRAMES		TEST QUESTIONS	
	#	%	#	%
I. Court Lines and Areas	26	12	3	8
II. Serving Rules	59	27	12	29
III. Scoring Rules	69	31	20	48
IV. Changing Sides of the Net	10	4	1	2
V. Doubles Game: Serving and Receiving Orders	55	26	5	13

that one student was knowledgeable about tennis rules and the other two subjects had no previous background in this area. This differentiation proved to be helpful in evaluating the program for various levels of previous exposure to the material.

Each student kept the program for one week. They responded in written form and identified every frame where an incorrect response was recorded. The explanation for the incorrect response was written on the response side of each page. The information given through these explanations helped the programer locate weaknesses in the program construction.

All three of the students took the program in the ordered sequence as the effectiveness of the sequential order was of primary interest at this time. Minor changes were made in the sequential order of the program and some of the test items were revised as a result of the pilot study. The results of this pilot study suggested that the program was more beneficial to the students with little knowledge about the subject material than to the student with previous exposure to the material. (See Table II).

Program Manual Preparation

The most widely used form for programed frames is in a programed text. (19). The necessity to design a format which could be administered in two sequential orders led to

TABLE II

RESULTS OF ADMINISTRATION OF THE TENNIS RULES PROGRAM IN A PILOT STUDY

SUBJECT	PRE-TEST	POST-TEST	PROGRAM	PROGRAM
Number	Score	Score	Time	Error Rate
1	35	37	59 min.	0
2	22	40	118 min.	8
3	23	40	140 min.	11

the decision to use a horizontal format for the ordered sequence and a vertical format for the scrambled sequence. The dual sequential order within the same program made it necessary to eliminate the use of frame numbers. The decision to put the correct response on the back of the page was made in an attempt to eliminate looking ahead for the right response before it was necessary.

All of the stencils were typed on multilith mats which were run on a multilith machine. A partial spiral binding of the manual was used for economy.

Administration of the Pre-Test

Prior to the administration of the pre-test, the subjects were given an explanation of the purpose of the study and their role in it. The pre-test was administered to the subjects during a regularly scheduled class period. Each student was given a copy of the forty-four item test, an answer sheet, and a pencil. The students were asked not to answer any question when they did not know the pertinent information. It was carefully explained and reiterated that this was not a test per se, but was to serve as a basis for comparison. Thus their answers needed to be a true reflection of their present knowledge of tennis rules.

Each student recorded the amount of time it took to complete the test. This information was used to help equate the groups. Each answer sheet was scored on the basis of

the total number of correct responses.

Program Administration

The programer met with each class at the class period following the administration of the pre-test. Since each class contained subjects which would take the program in ordered and scrambled sequence, the program was explained to each group separately. After each subject was given a copy of the program, the instruction sheet was read by the programer. The terminology was explained to each group and the manner in which they were to take the program was explained in detail. An explanation of the recording and evaluation sheet followed. The students were asked to record the amount of time it took them to complete each chapter. They were told that this was not testing them against time but would serve merely as an indication to the programer of the average amount of time it would take to complete the program. The students were also asked to check the frame each time they had an incorrect response and then explain the reason why they had answered as they did. It was stressed that this was an evaluation of the program and not of their ability to respond correctly. The need for an honest criticism was emphasized. The students were asked to total the number of incorrect responses and record this number in the error rate column on the recording and evaluation sheet. The students were then told to answer the evaluation

questions on the back of this sheet. They were asked to react to this type of learning and indicate any improvements they might have for the program. Additional comments were also solicited. (See Appendix C).

Since only fourteen students were familiar with programed instruction it was necessary to explain the procedures in considerable detail. The group using the scrambled sequence were told that it would be necessary to use a cover sheet when checking their responses. This procedure was demonstrated and it was suggested that a 3 x 5 card would be suitable as a cover sheet. The students were told that they would have the programs for one week. At the end of that week, they would again be tested on tennis rules. It was stressed that the program was to serve as their only resource for tennis rules. The programer returned to the next class meeting to answer any questions.

The literature reflects a trend toward using programed instruction effectively to learn specific skills within a given time period. (3, 24, 29) Since it is necessary to learn tennis rules before actual game play can begin, programed instruction could eliminate the teaching of rules from valuable class time and still have the students learn the rules effectively. The decision to give the subjects the program for one week and then re-test was to ascertain the feasibility of using programed learning in this manner. Due to the relatively little time needed to

complete the program, the programer felt that the seven day limit was appropriate. All of the students would have the necessary information at a given time and still have learned at individual rates.

Administration of the Post-Test

One week following the distribution of the programs, the programer returned to the classes to administer the post-test. The programs were collected and any remaining questions were answered before the test was given. The students were told to view the post-test as their rules test for the course although it was not a factor in their grade. Each subject received a test, an answer sheet and a pencil. The answer sheets were scored on the basis of the total number of correct responses.

Treatment of Data

The scores obtained from the pre-test for the total test population were used to divide the subjects into matched pairs. After the post-test administration statistical procedures were employed to determine the mean and standard deviation of the following groups: 1) total test population; 2) ordered sequential group; and 3) scrambled sequential group.

In order to determine any significant knowledge gain, the mean scores obtained from the two test administrations were subjected to the Fisher "t" test of significance of

difference for large correlated groups (38) in the following groupings: 1) total test population; 2) ordered sequential group; and 3) scrambled sequential group. The .05 per cent level of confidence was accepted as the critical level for all tests of significance.

The means and standard deviations of the two sequential techniques regarding the following: 1) knowledge gain; 2) error rate; and 3) time to complete the program; were also computed.

In addition to the tests of significance to determine the amount of knowledge gain, the Fisher "t" test of significance for large uncorrelated groups was used to ascertain whether or not there was a statistically significant difference between the ordered and scrambled sequential techniques in the following instances: 1) knowledge gain; 2) error rate; and 3) time to complete the program.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

The purpose of this study was to test the effectiveness of ordered and scrambled sequential presentation in the programed instruction of tennis rules. A secondary purpose of this study was to observe the effectiveness of programed instruction as the only source of information available when learning tennis rules.

The subjects in the study were sixty-two college men and women enrolled in beginning tennis classes during the spring semester, 1967-68, at the University of North Carolina at Greensboro.

Each statistical procedure employed is analyzed and interpreted in the following discussion.

PROGRAM VALIDITY

The validity of the program was determined according to the standard of the American Research Institute as cited by Woolen. (73) Thus, 90 per cent of the subjects must correctly respond to 90 per cent of the total number of responses within the program. Within the 219 program frames there were 316 responses. With this standard, it was necessary for a minimum of fifty-six subjects to have a minimum

of 284 correct responses and no more than six subjects could miss more than thirty-two responses. (Table III) It is interesting to note that the SSG error rate fell within the accepted range for program validation.

Error Rate

There proved to be a significant difference in error rate for the two sequential methods. The mean number of errors for the ordered sequence group (OSG), was 3.46. The scrambled sequence group (SSG), had a mean error score of 17.276. (Table IV). The mean difference produced a "t" of 10.48. This figure is much greater than the necessary "t" of 2.457 at the .01 per cent level of confidence. Those subjects who completed the program with an ordered sequence made significantly fewer errors within the program. Yet considering the fact that there was no significant influence of either sequence on the amount of knowledge gained, the writer suggests that the principle of errorless learning in programed instruction might be questionable.

Program Completion Time

The amount of time necessary to complete the program was also significantly different for subjects using the two methods of sequencing. The mean completion time for the OSG was 68.45 minutes while the SSG took 79.06 minutes to complete the program. The obtained "t" of 2.643 was significant at the .05 per cent level of confidence. (Table IV).

TABLE III

PROGRAM VALIDITY

ERROR RATE		SUBJECTS			
Number	%	Ordered	Scrambled	Total	Cum %
0	0	6		6	10
1	.03	8		8	23
2	.06	4	1	5	30
3	.09	0	1	1	32
4	1.26	3		3	37
5	1.58	1		1	39
6	1.89	3	2	5	46
7	2.22	1	2	3	51
8	2.53	1		1	53
9	2.85	2		2	56
10	3.16	1		1	58
11	3.48		2	2	61
12	3.79		1	1	63
13	4.11	1	1	2	66
14	4.43		2	2	68
15	4.75		1	1	70
16	5.06		1	1	72
17	5.38				
18	5.69		3	3	77
19	6.01		1	1	79
20	6.33		2	2	82
21	6.65		2	2	85
22	6.96				
23	7.28		2	2	88
24	7.59		2	2	91
25	7.91				
26	8.23				
27	8.54				
28	8.86		1	1	93
29	9.18		1	1	95
30	9.49				
31	9.81		3	3	100

N = 62
Number Responses = 316

TABLE IV

COMPARISON OF TWO SEQUENTIAL TECHNIQUES
OF PROGRAM PRESENTATION

IMPROVEMENT

TECHNIQUE	N	RANGE	$\bar{X}$	s	M_{diff}	"t"
Ordered	31	1-32	20.112	7.942	.644	.3069
Scrambled	31	1-31	19.468	8.298		

.01% level of confidence "t" = 2.750 with 30 df

ERROR RATE

TECHNIQUE	N	RANGE	$\bar{X}$	s	M_{diff}	"t"
Ordered	31	0-13	3.46	3.50	16.93	10.48
Scrambled	31	2-31	17.276	8.122		

.01% level of confidence "t" = 2.750 with 30 df

PROGRAM COMPLETION TIME

TECHNIQUE	N	RANGE	$\bar{X}$	s	M_{diff}	"t"
Ordered	31	38-122	68.45	15.375	9.61	2.634
Scrambled	31	53-110	79.06	4.029		

.05% level of confidence "t" = 2.457 with 30 df

The subjects who took the ordered sequence were able to complete the program significantly faster than the subjects who took the scrambled sequence.

PRE-TEST AND POST-TEST SCORES

Total Test Population

The relatively low pre-test mean (See Table V) indicated that the total test population possessed minimal knowledge concerning tennis rules.

The pre-test and post-test scores were used to determine the mean improvement for the group. The statistical significance was determined by calculating the "t" test for correlated groups. (38)

The knowledge gain proved to be significant at the .01 per cent level of significance. (Table V). The null hypothesis can be rejected at this confidence level with a "t" as high as 2.617. The knowledge gain of the total test population produced a "t" of 19.389. This is far above the critical level for a significant difference.

Ordered and Scrambled Test Groups

The pre-test and post-test scores of each group were used to determine the significance of the knowledge gain within each group. The mean scores were used to determine the improvement gain by using the "t" test for correlated groups. The knowledge gain for the scrambled sequence group

TABLE V

COMPARISON OF PRE-TEST AND POST-TEST PERFORMANCES FOR THE TOTAL GROUP AND THE SCRAMBLED AND ORDERED GROUPS

TOTAL GROUP

TEST	N	RANGE	$\bar{X}$	s	M_{diff}	"t"
Pre-test	62	4-36	17.726	7.750	19.9516	19.3893
Post-test	62	31-44	37.661	2.712		

.01% level of confidence "t" = 2.617 with 61 df

SCRAMBLED GROUP

TEST	N	RANGE	$\bar{X}$	s	M_{diff}	"t"
Pre-test	31	4-36	17.726	8.264	20.129	13.997
Post-test	31	33-44	37.806	2.320		

.01% level of confidence "t" = 2.750 with 30 df

ORDERED GROUP

TEST	N	RANGE	$\bar{X}$	s	M_{diff}	"t"
Pre-test	31	5-33	17.726	7.962	19.774	13.225
Post-test	31	31-43	37.516	3.046		

.01% level of confidence "t" = 2.750 with 30 df

(SSG) produced a "t" of 13.997. The knowledge gain of the ordered sequence group (OSG) produced a "t" of 13.225. Both are far above the criterion "t" of 2.75 for the .01 per cent level of confidence. The knowledge gain for all groups is indicated by the large mean difference for each group. (Table V).

ORDERED AND SCRAMBLED GROUP IMPROVEMENT

The improvement scores for each test group were used to determine a difference in the effectiveness of the sequential techniques. The significance of differences between the mean improvement for the groups was determined by the "t" test for uncorrelated groups. The test of significance of difference of the two sequential methods yielded a "t" equal to .3069. (Table IV). This was not high enough to be statistically significant. The lack of statistical significance indicated that neither method of sequencing used in this study had a greater influence on the amount of material learned by the subjects.

EVALUATION

In an attempt to obtain student evaluation of the program, the students were asked to comment on the back of the Information and Evaluation Sheet. They were specifically asked to state their reaction to this type of learning and to make suggestions for program improvement. (Appendix C).

The overall reaction by the students was in favor of the program. Used in differing contexts, many students used the term "enjoyable" when describing their reaction to this type of learning. Although only 13 per cent of the subjects actually stated that programed learning was better than learning rules from a text, it is the opinion of the writer that the program eliminated the dull, rote memorization usually associated with learning rules and therefore the experience was an "enjoyable" one. Seven per cent of the subjects did not like having to turn the page to check each response.

Among the reactions of the OSG, 10 per cent of the subjects did not like the repetition within the program and 13 per cent thought that the program was too elementary. The subjects in the OSG felt that it was often possible to answer without actually comprehending the material. It is the opinion of the writer that the overuse of repetition within the program made this possible.

The SSG was concerned with the lack of unity within the program. Thirty-five per cent of the subjects in this group expressed this dissatisfaction. They wanted to have the information given to them before they were asked to apply it. It is interesting to note that 13 per cent expressed a liking for the repetition within the program. The writer suggests that the repetition in a scrambled sequence actually serves the purpose of spaced review and as

such, the repetitive items are not presented too closely together. Although the knowledge gain for the total test population was significant, it is the opinion of the writer that these scores were not as high as they should have been. There were plausible reasons for this situation.

After reviewing the subjects' rationale for program errors, as well as reactions to and criticisms of the program, the writer suggests that the program itself was not as effective a teacher as it should have been. After determining the item error rate on the post test and reviewing the area of the questions, the program areas which were not effective, as determined by the post-test, were noticeable. (See Appendix K). Thus the lack of learning and the subsequent incorrect post-test responses may be inherent in the program itself.

In summary, there was no statistically significant difference in the amount of learning through programed instruction using ordered and scrambled sequential methods. However there was a significant difference in error rate and program completion time in favor of the ordered sequential technique.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was to test the effectiveness of ordered and scrambled sequential techniques in the programed learning of tennis rules. The program was designed for use in beginning tennis classes on the college level. A secondary purpose of the study was to observe the effectiveness of programed instruction as the only source of information available when learning tennis rules.

The subjects in the study were sixty-two college men and women enrolled in beginning tennis classes during the spring semester, 1967-68, at the University of North Carolina at Greensboro.

The rules to be programed were selected and divided into five specific areas. Terminal objectives were established from the predetermined rules selection. The sequential order of presentation within each section was then determined.

A forty-four item objective knowledge test was designed to be used as a pre-test and a post-test to determine the amount of knowledge gained through implementation of the program.

A pilot study was conducted to ascertain needed revisions in the program and the knowledge test. Minor

revisions in both the program and the knowledge test were made. The program was then run on a multilith multigraph machine. An Information and Evaluation Sheet, two panels of court diagrams and a blank sheet of paper were included with each copy of the program.

A pre-test was administered to the subjects in order to determine their initial knowledge of tennis rules and to serve as the basis for matched pair selection for the two sequential groups. The pre-test was administered during a regularly scheduled class period.

One half of the test population were given programs with an ordered sequence and one half were given programs with a scrambled sequence. Each student was asked to complete the program outside class time. All incorrect responses, time taken to complete the program and an evaluation of the program were recorded by the students and handed in with the program. The programer attended the next regularly scheduled class period to answer any questions and lead any discussion that was needed.

All the subjects were retested in a regularly scheduled class period seven days after receiving the program.

Findings

1. The pre-test and post-test scores for the total test population were compared. The matched pair design was employed to determine the mean improvement of the total

group. The mean improvement was subjected to the "t" test to determine statistical significance. The resulting "t" of 19.389 was statistically significant at the .01 per cent level of confidence. A high degree of knowledge gain is evidenced by these data.

2. The pre-test and post-test scores for each sequential method were compared for each group. Both mean improvement scores were quite large. The ordered sequential group had a mean improvement of 19.774 and the scrambled sequence group had a mean improvement of 20.129. Both of these figures were statistically significant at the .01 level of confidence. A high degree of knowledge gain is shown for each sequential method by these data.

3. The improvement scores for each of the groups were compared to determine if either sequential technique was more effective than the other. The obtained "t" was .3069 and was not significant at the .01 per cent level of confidence. In this study, neither sequential order proved to be a more effective method of presentation.

4. The program was found to be valid according to the standards of the American Institute for Research as more than 90 per cent of the subjects had less than a 10 per cent error rate. The mean error rate for the scrambled sequence group was 17.276 or 5.39 per cent for the group. The mean error rate for the ordered sequence group was 3.46 or 5 per cent for the group. Since there was no significant

difference in learning by either sequential method, the necessity for errorless learning is questioned.

5. The average amount of time required for the ordered sequence group to complete the program was one hour and eight minutes. The average amount of time required for program completion for the scrambled sequence group was one hour and nineteen minutes.

6. The ordered sequential program proved to take a significantly shorter amount of time to complete than the scrambled sequential program. As well as producing a significantly smaller error rate.

7. An appraisal of the student evaluations indicated that a majority of the students favored this type of instruction and that this specific program was regarded as an enjoyable and effective method of learning tennis rules.

8. The results of this study were similar to those of Roe (63) which found no statistically significant difference between the effectiveness of ordered or scrambled sequential techniques.

9. The results of Levin and Baker's work (52) was also substantiated by this study as there was no statistically significant difference between knowledge gained with either sequential presentation.

Conclusions

Within the framework of this study the following

conclusions were made:

1. There was no significant difference in the effectiveness of ordered and scrambled sequential techniques in the programed learning of tennis rules.

2. Programed instruction can be used effectively as the only information source for learning tennis rules.

3. The constructed program, Tennis Rules: A Programed Manual, is a valid unit of programed instruction although not as effective as it should be.

4. Programed instruction is an effective method of learning and teaching that could eliminate the necessity to teach tennis rules within the framework of the class situation.

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APPENDIX

APPENDIX A

PROGRAM OBJECTIVES

CHAPTER ONE

COURT LINES AND AREAS

The student must be able to:

A. Draw and label the court lines and areas for a singles tennis court.
   1. Lines: service, base, side
   2. Areas: fore court, back court, right and left service courts

B. Draw and label specific court lines and areas for a doubles tennis court.
   1. Lines: base, side
   2. Areas: right and left service courts, alley

CHAPTER TWO

SERVING RULES

The student must be able to:

A. Understand and write the relationship between a legal serve and correct court positioning to begin serving the game.
   1. Hitting the ball before it bounces
   2. Using either an underhand or overhand serve while
   3. Standing behind the base line

4. Standing behind the right service court

B. Write and apply the regulations concerning improper alternation of service.

1. The mistake is corrected immediately
2. Any points scored before discovery of mistake will count

C. Write specific facts about a let service.

1. Is not a fault
2. Is re-served

D. Write specific facts about serving faults.

1. Ball does not enter proper service court
2. Server steps on or over the base line while serving
3. The ball hits a permanent fixture before hitting the ground
4. The server attempts but misses the ball

E. Write specific facts about readiness to receive.

1. Receiver must be ready before the server may serve
2. Receiver makes no attempt to return serve, server may not claim a point

CHAPTER THREE

SCORING RULES

The student must be able to:

A. Name the points in a tennis game.

1. Fifteen
2. Thirty

3. Forty

4. Game

B. Define and apply the concept of DEUCE and ADVANTAGE.

1. When both players have three points

2. First point after deuce

a) Won by receiver - advantage out

b) Won by server - advantage in

C. Name and apply the relationship between the three units in tennis scoring.

1. Game - player with a minimum of four points and is two points ahead of the opponent

2. Set - player who won a minimum of six games and is two games ahead of the opponent

3. Match - player has won a specific number of sets

a) Women - two out of three

b) Men - three out of five

D. List the ways to lose a point in tennis.

1. Player does not return the ball in play before it bounces a second time

2. Player returns the ball in play so that it hits outside the opponent's court

3. Player strikes the ball in play more than once

4. Player or his racket touches the net while the ball is in play

5. Player reaches over the net to hit the ball in play

CHAPTER FOUR

CHANGING SIDES OF THE NET

The student must be able to:

A. Write and apply the rule concerning the time to change sides of the net.

   1. At the end of every odd numbered game
   2. At the end of a set unless the total number of games played is even

CHAPTER FIVE

DOUBLES GAME; SERVING AND RECEIVING ORDERS

The student must be able to:

A. Understand and apply concept of serve alternation in a doubles game.

   1. Serving team changes sides of the court after each point
   2. One team serves the even numbered games
   3. One team serves the odd numbered games
   4. Mistake in serving order is corrected immediately
      a) points made before discovery shall count
      b) any fault made before discovery shall count
   5. Remains as altered if served out of turn entire game

B. Understand and apply concept of receiving order in a doubles game.

   1. One partner receives the first serve of each game served by opponents

2. Mistake in receiving order is corrected at the end of the game

C. Write relationships between receiving and serving orders

1. Both are decided at the beginning of each set

2. Both are decided independently of each other

APPENDIX B

RULES TO PROGRAM

I. Court lines and areas

A. Court lines

1) The boundary lines are the side lines and the base lines.

2) The service line divides the service area from the rest of the court.

B. Court areas

1) The area located behind the service line is the back court.

2) The area located in front of the service line is the fore court.

3) The service courts are known as right and left service courts.

4) The alley is the added width used in the doubles game.

5) The service area remains the same for both singles and doubles games.

II. Serving rules

A. Placement and execution

1) The server must hit the ball before it strikes the ground.

2) The server may use an underhand or an overhand serve.

3) The server shall stand behind the baseline and shall serve alternately from behind the right and left courts.

4) The first service of each game will be served from behind the right service court.

5) The serve must land within the service court diagonally opposite the server.

6) All lines bounding the service areas are considered in-bounds.

B. Wrong side of the court.

1) If the server serves from the wrong half of the court, the error is corrected immediately.

2) Any points scored before discovery shall be counted.

C. Fault

1) A fault is committed if the ball does not land in the proper service court.

2) The service is a fault if the server misses the ball in attempting to strike it.

3) A fault is committed if the server steps on or over the base line while serving.

4) The service is a fault if it hits any permanent fixture that is out-of-bounds.

5) The server has two attempts to make the service

good.

6) After the first fault, the ball is served from the same side of the court.

7) If the server commits a second fault, it is called a double fault.

8) When the server commits a double fault he loses the point.

D. Ways to lose a point

1) Player does not return the ball in play before it bounces a second time.

2) Player returns the ball so that it hits outside the opponent's court.

3) Player strikes the ball more than once in returning it across the net.

4) Player or his racket touches the net while the ball is in play.

5) Player reaches over the net to hit the ball in play.

III. Scoring rules

A. Points

1) The first point in tennis is called fifteen.

2) The second point in tennis is called thirty.

3) The third point in tennis is called forty.

4) The fourth point in tennis is called game.

5) A score of zero is called love.

B. Advantage

1) When both players win three points, (40-40), it is called deuce.

2) The next point won by a player after deuce is called advantage.

3) If the server has the advantage it is called advantage in.

4) If the receiver has the advantage it is called advantage out.

5) If the player with the advantage wins the next point it is game.

6) If the player with the advantage loses the next point it is deuce.

C. Game, set and match

1) To win a tennis game a player must win a minimum of four points.

2) To win a set a player must win six games and be ahead of his opponent by at least two games.

3) To win a match a woman must win two out of three sets.

4) To win a match a man must win three out of five sets.

IV. Changing sides of the net

A. Singles game

1) The players change sides of the net at the end of every odd numbered game.

2) The players also change sides of the net at the

end of each set unless the total number of games is even.

3) If the total number of games at the end of a set is even, the players change sides of the net at the end of the first game of the next set.

V. Doubles game: serving and receiving orders.

A. Serving order

1) The partner of the player who serves the first game will serve the third game.

2) The partner of the player who serves the second game will serve the fourth game.

3) This order will stand throughout the set.

B. Receiving order

1) The order of receiving will be decided at the beginning of each set.

2) The partner receiving first will receive the first service in every odd numbered game in the set.

3) The opponent who receives first will receive the first service in every even numbered game in the set.

4) Partners will receive the serve alternately throughout each game.

5) If the order of receiving the service is changed during a game, it will remain as altered until

the end of the game.

6) Partners will resume original receiving order at the end of this game.

C. Serving out of turn

1) If a partner serves out of turn, his partner will serve as soon as the mistake is discovered.

2) All points scored before discovery shall count.

3) A fault served before discovery shall count.

4) If a game is completed before discovery, the order of service remains as altered.

APPENDIX C

NAME _____

SECTION _____

INFORMATION SHEET

RECORDING AND EVALUATION

Whenever you have a response that differs from the correct response, check (X) that frame. Explain WHY you answered as you did on the response side of the page. Total the number of checks you have for each chapter and record this number on the chart below. Keep track of the amount of time it takes you to complete each chapter and record this on the chart below.

CHAPTER	TIME	ERROR RATE
I Court Lines and Areas		
II Serving Rules		
III Scoring Rules		
IV Changing Sides of the Court		
V Doubles Game: Serving and Receiving Orders		
TOTALS		

On the back of this sheet please answer the following questions:
What is your reaction to this type of learning?
What suggestions do you have to improve this program?
Any additional comments would be appreciated.

APPENDIX D

INSTRUCTION SHEET
ORDERED SEQUENCE

NAME_____ SECTION_____

This is a programed manual designed to teach you tennis rules. Each page is divided into seven horizontal bands. Each band is called a frame and contains information about the rules. In some frames one or more words are missing. You will be required to fill in the missing word(s) before turning the page where you will find the correct response. You are to respond to the top frame on ALL the pages in Chapter I. Then return to the beginning of Chapter I and go through the second band. When you reach the end of the second band in Chapter I, return to the beginning and do band three. Proceed in this manner step-by-step until you have covered all the pages in Chapter I. Then proceed to Chapter II where you will again start with the first band at the top of the page. You will proceed in this manner throughout the program.

You will learn more effectively from this manual if you do not look to the correct response until you have written your own response and if you will stop only at the end of a chapter. Properly used, this manual will teach you the basic tennis rules.

APPENDIX E

INSTRUCTION SHEET
SCRAMBLED SEQUENCE

NAME_____ SECTION_____

This is a programed manual designed to teach you tennis rules. Each page is divided into seven horizontal bands. Each band is called a frame and contains information about the rules. In some frames one or more words are missing. You will be required to fill in the missing word(s) before turning the page where you will find the correct response. You are to begin with the top band and respond to all of the frames on the first page before going to the next. You are to look at the correct response after completing EACH frame. Proceed in this manner page-by-page until you have covered all of the pages in Chapter I. Then proceed to Chapter II where you will again start with the top band. You proceed in this manner throughout the program. Use the Panels whenever necessary to answer the questions.

You will learn more from this manual if you do not look to the correct response until you have written your own response and if you will stop only at the end of a chapter. Properly used, this manual will teach you the basic tennis rules.

APPENDIX F

TEST ON TENNIS RULES
PROGRAMED INSTRUCTION

Please Do Not Write on the Test!

Matching (Place the letter of the statement given in the right hand column that defines the term given in the left hand column in the blank on your answer sheet).

1. advantage in	a. a serve that must be replayed.
2. foot fault	b. first point after deuce won by the receiver.
3. let service	c. the server attempts to hit the ball and misses.
4. double fault	d. first point after deuce won by the server.
5. advantage out	e. serve lands outside the intended service court.
	f. server steps on the base line while serving.
	g. the failure of two service attempts to land in the proper service court.

Multiple Choice (Place the letter of the statement which best answers the question in the space provided on your answer sheet).

1. When is a point NOT lost in tennis?
   a. the ball is hit into the net.
   b. the ball lands outside the boundary lines.
   c. the ball bounces on one of the side lines or base lines during play.
   d. the player hits the ball after two or more bounces.

2. When is it NOT a fault in tennis?
   a. the server steps on the base line while serving.
   b. the serve hits the net and lands in the proper service court.
   c. the server attempts to hit the toss but misses it.
   d. the serve lands outside the intended service area.

3. When is it NOT considered a "let" in tennis?
   a. the serve hits the net and bounces in the alley.
   b. the serve hits the net and bounces in the intended service area.
   c. the ball is served before the receiver is ready.
   d. the second service hits the net and lands in the proper service court.

4. When is the serve NOT properly executed?
   a. the ball is served before it strikes the ground.
   b. the server uses an underhand serve.
   c. the ball is served from behind the right service court and base line.
   d. the serve lands in the service court directly opposite the server.

5. When do the players NOT change sides of the net?
   a. at the end of every odd numbered game.
   b. at the end of each game.
   c. at the end of the set when the total number of games is odd.
   d. at the end of the first game of the next set when total number of set games is even.

6. The server wins the first point. The receiver wins the second point. The server serves the next ball into the net. What is the score?
   a. 15 - 15
   b. 30 - 15
   c. 15 - 30
   d. 15 - 40

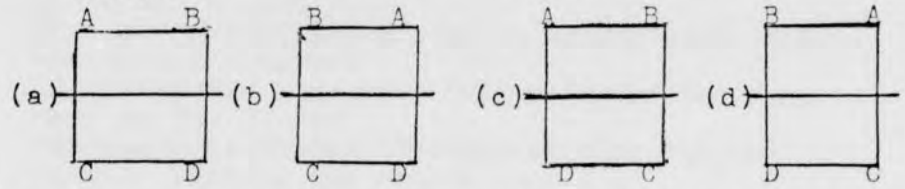
7. The score is 30-30. The receiver wins the next point. The server wins the following point. What is the score?
   a. 40 - 30
   b. deuce
   c. advantage in
   d. advantage out

8. The ball is served before the receiver is ready; the receiver hits the ball into the net. What is the correct decision?
   a. server's first fault.
   b. point for the receiver
   c. point for the server
   d. let service

9. The receiver wins the first point after deuce. What is the score?
   a. game
   b. advantage in
   c. 40 - 30
   d. advantage out

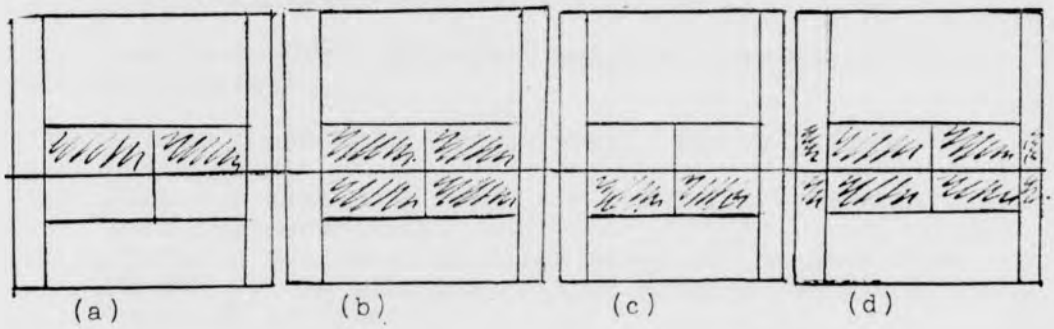
10. Player A served and won the first point. She served to Player D. Which of the following shows the

correct positioning for ALL players for the next serve?

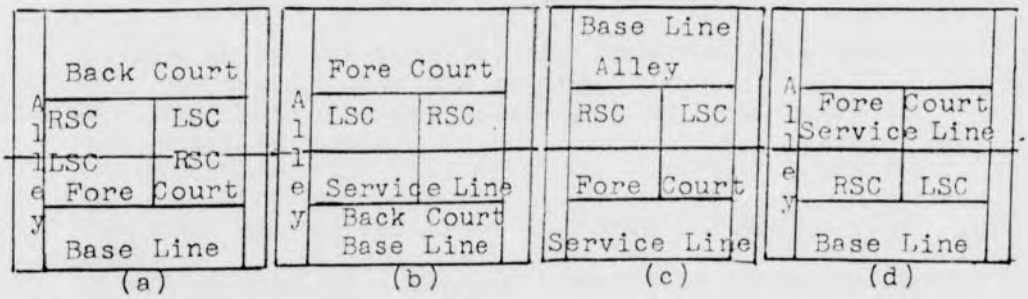


11. Which of the following shows a singles service court properly shaded?

12. Which of the following shows a doubles service court properly shaded?



13. Which of the following courts is properly marked?



Short Answer (Place the correct word or phrase in the space provided on your answer sheet).

1. What are the four points in a tennis game?
2. What is a score of zero called?
3. How many consecutive points after deuce must be won to win a game?
4. What is a score of 40-40 called?
5. What is the minimum number of games that must be won to win a set?

6. How many games ahead of the opponent must a player be to win a set?
7. In women's tournament play, how many sets must be won to win a match?
8. If the server wins the first point of the game, what is the score?
9. The score is deuce. The server wins the next point. What is the score?
10. The receiver wins the first three points of the game. What is the score?
11. In tournament play how many sets must a man win to win the match?
12. In doubles does the receiving team change sides of the court after each point is made?

For questions 13-15, Players A and B are partners. C and D are partners.

13. Player A served the first game. Who will serve the third game?
14. Player D served to A and won the point. To whom does she serve next?
15. Player D received the first serve of the game from Player A. To whom does Player B serve the first serve of her game?

Legal or Fault (Place an (L) in the space provided on your answer sheet if the situation below is legal; if it is a fault, use an (F)).

1. On return of the service, the receiver hits the ball before it hits the ground.
2. The ball hits the net while in play, and lands in the opposite court.
3. While hitting the ball in play, a player touches the net with his racket.
4. The same player continues to serve throughout the game.
5. In the middle of a game, a mistake is found in the serving order.
6. The server tosses the ball and catches it without attempting to hit it.
7. The receiver hits the ball twice in making the play.
8. Partners A and B change receiving order after the third game of the set.

APPENDIX G

NAME_____ SECTION_____ TIME_____

ANSWER SHEET

TENNIS RULES - PROGRAMED INSTRUCTION

Place the answer you select in the blank beside the question number.

Matching

1. d
2. f
3. a
4. g
5. b

Multiple Choice

1. c
2. c
3. a
4. d
5. c
6. c
7. b
8. c
9. d
10. b
11. b
12. b
13. d

Short Answer

1. 15-30-40-game
2. Love
3. 2
4. deuce
5. 6
6. 2
7. 2 out of 3
8. 15-love
9. add in
10. love-40
11. 3 out of 5
12. No
13. b
14. b
15. d

Legal or Fault

1. F
2. L
3. F
4. L
5. F
6. L
7. F
8. F

APPENDIX H

TENNIS RULES:

A PROGRAMED MANUAL

TENNIS RULES

A PROGRAMED MANUAL

FRANCES MARIELLO

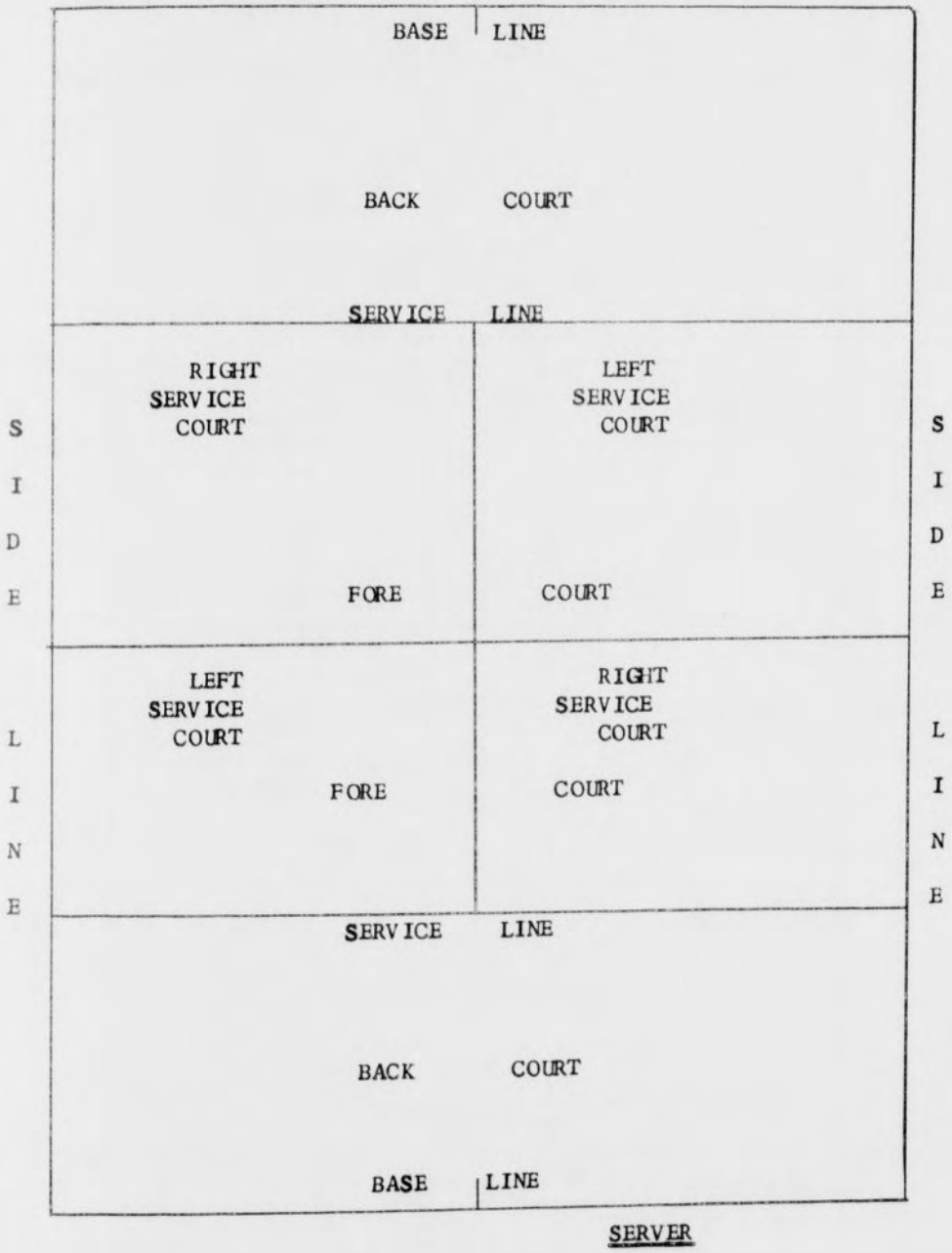
TENNIS RULES

A PROGRAMED MANUAL

FRANCES MARIELLO

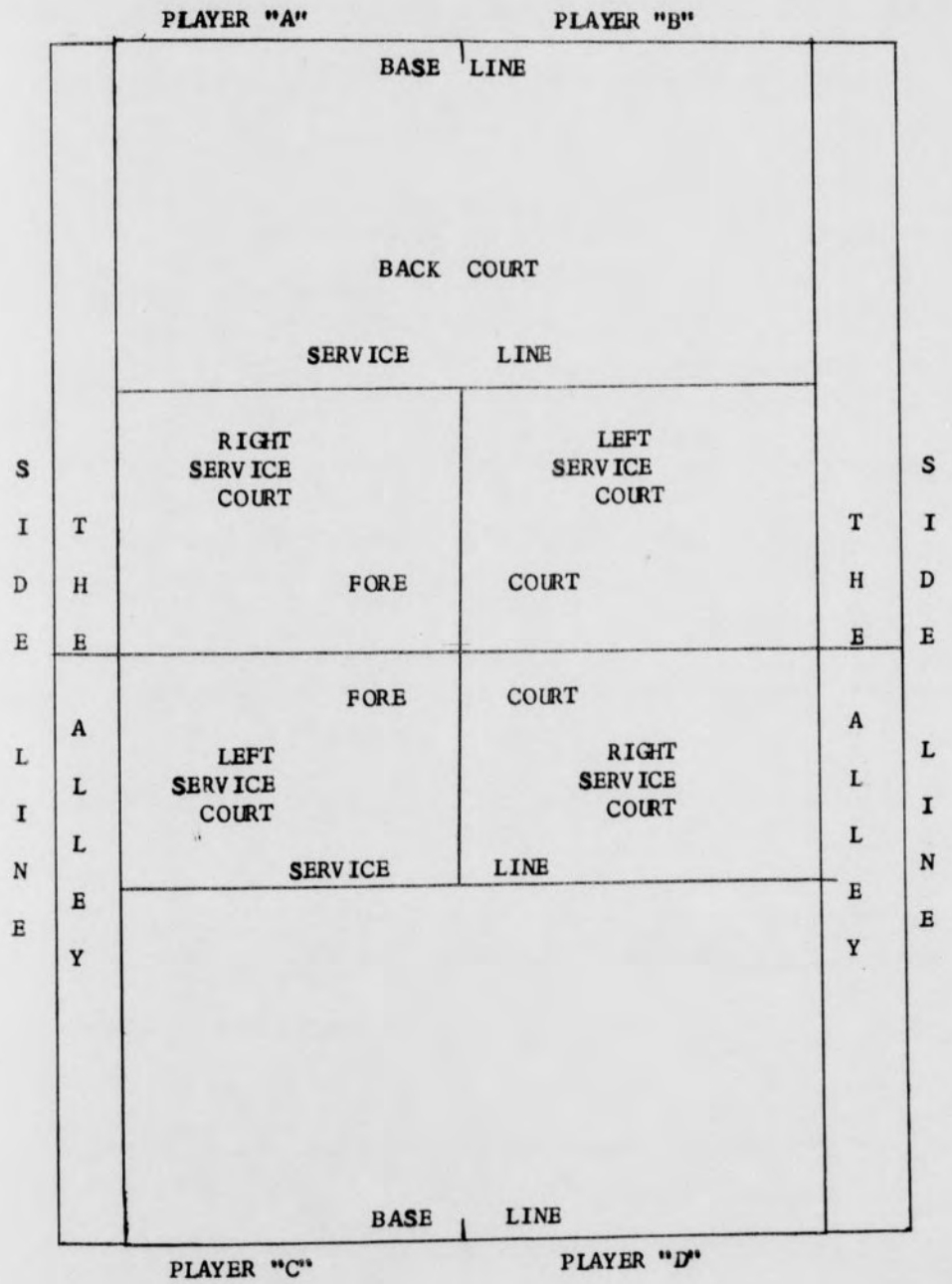
PANEL 1

SINGLES TENNIS COURT



PANEL 2

DOUBLES TENNIS COURT



Chapter I Court Lines and Areas

The game of tennis is played on a t _____ court.

The b _____ court is the area BEHIND the service l _____ .

The _____ _____ is in front of the service line.

The _____ _____ is BEHIND the _____ line.

What are the names of the service courts?

1. _____

2. _____

A tennis court is bounded by s_____ lines and b_____ lines.

The playing area for a DOUBLES TENNIS GAME is wider than for a singles game.

Look at the GREEN Panel, Panel 2.

The added width is called the a_____ .

The s _____ court remains the same for both games.

99

tennis

---

back

line

---

fore court

back court

service

---

right service court

left service court

---

side

base

---

alley

---

service

The lines and areas of this court have specific names.

It is necessary for you to know these n _ _ _ _ _ before you learn the rules of the game.

The _____ c_____ area is BEHIND the s_____ line.

Which line separates the fore court and back court areas?

_____

The lines bounding the SIDES of the court are called the s _ _ _ lines.

The _____ line separates the f_____ and b_____ court areas.

The _____ makes the doubles court wider than the singles court.

Draw a doubles tennis court on the WHITE paper attached with Panels 1 and 2. Label the following:

1. side lines
2. base lines
3. alley
4. right and left service courts

101

names

---

back court

service

---

service line

---

side

---

service

fore

back

---

alley

---

check with Panel 2 (GREEN)

Look at the YELLOW panel, Panel 1 and refer to it when needed to answer the following questions.

Panel 1 is a diagram of a s_____ tennis court.

The court area in FRONT of the service line is called the

_____ _____ area.

Draw a singles tennis court on the WHITE paper attached with Panels 1 and 2. Label the following:

1. service line
2. fore court and back court

The BACK line of a tennis court is called the _____ line.

There are r_____ and l_____ service courts.

The service courts remain the SAME for both games.

A ball served into the a_____ in a doubles game is not a legal serve.

---

singles
fore court
check with Panel 1 (YELLOW)
base
right left
alley

What is the name of the COURT AREA behind the service line?

_____

The f _ _ _ court area is in _____ of the service l_____ .

There are r_____ and l_____ service courts.

The back line of a tennis court is called the _____ _____ .

Using the singles court you have drawn, label the following:

1. right and left service courts
2. base lines
3. side lines

The d_____ court is wider than the s_____ court

because of the a_____ .

back court

---

fore
front
line

---

right

left

---

base line

---

check with Panel 1 (YELLOW)

---

doubles

singles

alley

Chapter II Serving Rules

The game of tennis begins with a SERVE.

The person who begins the game is known as the _____ .

To begin the game in correct court position, the server must stand behind which LINE and which SERVICE COURT?

_____

_____

Player A served to Player B. Player B hit the ball into the net.
It was then discovered that Player A served from the wrong half of the court.

Does Player A lose the point she just made? _____

It is also a f_____ if the ball is in_____ly served.

The serve is also a fault if it hits any permanent fixture before it hits the court.

Whenever the service enters the p_____ s_____ court after h_____ the net, the ball is re _ _ _ _ _ _ .

If the receiver claims he is not ready and makes no attempt to return the s _ _ _ _ , the server may not claim a point.

107

server

base line

right service court

no

fault

incorrectly

proper service

hitting

reserved

serve

The server tosses the ball into the air and hits it before it b _ _ _ _ _ _ _ .

The serve is then ALTERNATED behind the right and _____ service courts after each POINT.

The served ball must land within the service court DIAGONALLY opposite from where the s_____ is standing.

If the ball is _____ served or does not enter the proper _____ _____ it is a f_____ .

If a served ball hits any p_____ fixture before it hits the court, it is a f_____ .

A l _ _ _____ is always re_____ .

The server must wait for the r _ _ _ _ _ _ _ to be ready for the second service as well as for the f _ _ _ _ .

109

bounces

left

server

improperly (incorrectly)

service court

fault

permanent

fault

let serve (service)

reserved

receiver

first

In order for a serve to be legal, the server must hit the ball before it b_____ .

The serve is alternated into each service court after <u>each</u> point. The server will serve the second point into the 1_____ service _____ .

Into which service court must the server in Panel 1 (YELLOW) serve the ball?

_____

The two situations which cause a fault are:

_____

_____

It is an improper service if the ball strikes a p_____ _____ before it hits the c_____ .

A let service is not considered a f_____ .

The server must wait for the receiver to be r_____ before serving the ball.

111

bounces

---

left

court

---

right service court

---

serve does not go into proper service court

ball is incorrectly served

---

permanent fixture

court

---

fault

---

ready

When the server contacts the ball before it hits the ground, it is a l_____ serve.

The third point would be served into the r_____ _____ _____.

This alternation continues throughout the game.

The server may use either the _____ or _____ serve to get the ball into the service court _____ opposite him.

The server may toss the ball and catch it if she decides not to serve that particular toss. However, if the server ATTEMPTS to hit the ball and MISSES, it is a f ___ ___ t.

It is a fault if:

1. the ball does not enter the p_____ service _____.
2. the server steps _____ or _____ the _____ _____.
3. the ball hits a _____ _____ before it hits the ground.
4. the server _____ but m_____ the ball.

When the server commits a let service on the first service, he has t ___ more chances to make the service good.

The players serve every other game in singles.

113

legal

right service court

overhand, underhand

diagonally

fault

1. proper, court
2. on, over, base line
3. permanent fixture,
4. attempts, misses

two

The server may use an underhand or an _____ serve.

Either serve is considered l_____ .

If the server serves from the wrong half of the court,

the error is corrected immediately.

The server must hit the ball before it _____ and the ball

must land in the r_____ _____ _____ to
BEGIN the game.

It is a fault if the server a_____ to hit the ball and m_____ .

The server has TWO attempts to make the service good.

A l_____ s_____ is not considered a f_____;

it is r_____ .

The player who served the first game would serve the t _ _ _ _ .

115

overhand

legal

---

bounces

right service court

---

attempts

misses

---

let serve (service)

fault

reserved

---

third

The only stipulation is that the server must contact the ball
before it _____ .

If the server s_____ from the w _ _ _ _ _ court,
the mistake is corrected immediately.

If the service lands on any line bounding the correct service court,
it is a legal _____ .

Two ways to commit a fault are:
1. if the serve does not enter the proper s_____ c _ _ _ _ _ .
2. if the server a_____ to hit the ball and misses it.

If the server steps over the b_____ _____ while serving,
he has committed a f_____ .
He now has _____ more chance(s) to make the service good.

The server may not s _ _ _ _ _ until the receiver is ready.

---

bounces

---

serves

wrong

---

serve

---

service court

attempts

---

base line

fault

one

---

serve

It is legal to use either an _____ or an _____ serve.

If the server s_____ from the _____ half of the c _ _ _ _ ,
the mistake is corrected _____ .

All lines bounding the service area are considered l_____ .

We have stated that the server must stand behind the _____ _____ .
A fault is committed if the server steps ON or OVER this line
while _____ .

When the served ball hits the net but goes into the p _ _ _ _ _
service court, it is called a LET SERVICE.

The receiver must be r_____ to receive the serve before the
serve is delivered.

119

underhand, overhand

---

serves
wrong
court
immediately

---

legal

---

baseline

serving

---

proper

---

ready

Examine Panel 1 (YELLOW). Refer to it as needed to answer the following questions.

The server is standing behind the _____ _____ .

He must stand behind this line each time he serves.

Any points scored before discovering that the server served from the wrong h_____ of the c_____ SHALL COUNT.

A served ball that does NOT enter the proper service court or is incorrectly served is called a FAULT.

If the server steps on the base line while serving and the ball lands in the proper service court, it is (a/an) (legal/illegal) serve.

_____ _____

A l __ __ serve is a served ball which enters the proper service court after hitting the n __ __ .

If the service is delivered and the receiver attempts to return it, he will be deemed r __ __ __ __ .

121

base line

half

court

an

illegal

let

net

ready

The server in Panel 1 (YELLOW) is standing behind which service court?

_____

The first service of each GAME is from behind this service court.

Any p _ _ _ _ _ _ scored before discovering that the server served from the _____ _____ of the court shall c _ _ _ _ _.

A fault is committed if the served ball does not enter the p _ _ _ _ _ _ service _____.

Three ways to commit a fault are:

1. to step _____ or over the _____ _____.
2. to attempt to hit the ball and _____ _____.
3. if the serve does _____ enter the _____ _____ court.

A let _____ is reserved.

Whenever the receiver attempts to r _ _ _ _ _ _ the serve, he will be deemed _____.

123

right service court

---

points
wrong half
count

---

proper

court

---

1. on, base line
2. misses it
3. not, proper service

---

serve (service)

---

return

ready

There are FOUR points in a tennis game.

The first p _ _ _ _ is called 15.

If the server has one point and the receiver has THREE points,

the score is _____ - 40.

When the server wins the _____ point,

it is called advantage _____ .

When the player with the advantage LOSES the next point,

the score returns to deuce.

If the set score is 6 - 3, is the set completed?

_____

To win a game, a player must win at least four p_____ .

If a player strikes the ball in play more than ONCE when attempting

to return the ball, he will lose a point.

125

point

15

advantage

in

yes

points

The second _____ is called 30.

The _____ point is called 40.

The score is 30 - 30.

Both players have _____ points.

If the score is advantage in, the _____ won the advantage point.

When the player with the a_____ loses the next p_____,

the score returns to d _ _ _ _ _ .

Player A won six games.
Player B won five games.

Is the set completed? _____

To win a set, a player must win at least _____ games and be

_____ games ahead of the opponent.

If a player strikes the ball in p_____ more than _____ when

attempting to return the ball, he loses a point.

127

point

third

---

two

---

server

---

advantage

point

deuce

---

no

---

six

two

---

play

once

The fourth _____ is called GAME.

A score of zero is called LOVE.

The server has no points and the receiver has three points.

The score is _____ - 40.

If the receiver wins the _____ p _ _ _ _ _,

it is called a_____ out.

The score is advantage in. The server loses the next _____ .

The score is now _____ .

In order to win a set, a player must win at least _____ games and

be ahead of the opponent by _____ games.

To win a woman's match, you must win _____ out of _____ sets.

A player loses a point if he:

1. does not return the ball in p_____ before it bounces a _____ time.
2. returns the ball so that it hits o_____ the opponent's court.
3. strikes the ball more than _____ when returning it.

129

point

---

love

advantage point

---

advantage point

advantage

---

point

deuce

---

six

two

---

two

three

---

1. play, second
2. outside,
3. once

When a player wins four p _ _ _ _ _ , he wins the g _ _ _ _ .

When both players have three points (40-40), the score is called DEUCE.

When the receiver wins the advantage _____ , the score is

_____ _____ .

The score is advantage out. The receiver wins the next point.

Did the receiver win the game? _____

Sets are arranged in units called MATCHES.

To win a man's match, you must win _____ out of _____ sets.

A player will also lose a point if he or his racket touches the net while the ball is in play.

131

points

game

---

point

advantage out

---

yes

---

three

five

The four points in a tennis game are 15, _____ , 40, _____ .

The score is 40 - 40. This is called d _ _ _ _ _ .

A player must win TWO CONSECUTIVE points <u>after</u> deuce to win the game.

Tennis games are arranged in units called SETS.

Sets are arranged in units called _____ .

A player <u>loses</u> a point if he does not return the ball in play BEFORE it bounces a <u>second</u> time.

A player will also lose a point if he or his r _ _ _ _ _ touches the n_____ while the ball is in p _ _ _ .

133

30

game

---

deuce

---

matches

---

racket

net

play

A score of zero is called _____ .

A score is deuce when both players have _____ points.

To win a game, a player must win two c_____ points after d _ _ _ _ .

Games are arranged in units called _____ .

A woman must win two out of three s _ _ _ to win a match.

A player l_____ a point if he does not return the ball over the net b _ _ _ _ _ it bounces a second time.

If a player or his r _ _ _ _ _ touches the _____ while the ball is in p_____ , he will lose a p_____ .

135

love

three

consecutive

deuce

sets

sets

lose s

before

racket

net

play

point

Name the four points in a tennis game.

1. _____ 3. _____

2. _____ 4. _____

The point after d _ _ _ _ is the ADVANTAGE point.

If the player who wins the advantage point wins the next point, he wins the game.

To win a set, a player must win SIX games and be ahead of his opponent by at least TWO games.

A man must win three out of five s _ _ _ to win a match.

One way to lose a point is to fail to return the ball before it b _ _ _ _ _ _ a s_____ time.

A player can also lose a point by reaching OVER THE NET to hit the ball in p _ _ _ .

137

15 40

30 game

---

deuce

---

sets

---

bounces

second

---

play

The server's score is always given f_____ .

The first point after deuce is called the a_____ point.

If a player with the advantage point wins the n ___ ___ point,
he wins the g ___ ___ .

If the set score is 6 - 4, the winner won six games and the loser
won _____ games.

To win a woman's match, you must win _____ out of three _____ .

A player loses a point if he returns the ball in play so that
it hits OUTSIDE the opponent's court.

If a player reaches o ___ ___ the n ___ to hit the ball in play,
he will lose a point.

139

first

advantage

next

game

four

two

sets

over

net

Whose score is always given first? _____

The a_____ point is the first point after _____.

The score is advantage in. The server wins the next point.

Does the server win the game? _____

In winning the set, the winner was _____ games ahead of the opponent and the winner had to win a minimum of _____ games.

To win a man's match, you must win _____ out of five _____.

A player loses a point if he r _ _ _ _ _ _ _ the ball in play so that it hits o_____ the opponent's court.

A player will lose a point if he:

1. reaches _____ the n_____ to hit the ball in play.
2. or his r_____ touches the net while the ball is in play.

141

server's

---

advantage

deuce

---

yes

---

two

six

---

three

sets

---

returns

outside

---

1. over, net

2. racket

If the server has two points and the receiver has a score of zero,

the score is 30 - _____ .

When the server wins the a_____ point,

it is called advantage in.

The score is advantage out. The server wins the next point.

Does the server win the game? _____

The winner won six games and was ahead of the opponent by two games.

The winner won the s_____ .

The three units in tennis scoring are:

g _ _ _ _ , s _ _ _ , and m _ _ _ _ _ _ .

If a player returns the ball in play so that it hits _____

the opponent's c_____ , he will lose a point.

143

love

advantage

no

set

games, sets, matches

outside

court

The players change sides of the net after every odd numbered game.

The set score is 3 - 3. The total number of games played is _____ .

Do the players change sides of the net? _____

Players USUALLY change sides of the net at the end of each set.

At the end of a set, if the t _ _ _ _ number of games is

e _ _ _, the players do not change sides of the net.

Players change sides of the net when the total number of games

is an _ _ _ number.

145

six

no

total

even

odd

The players change sides of the net after every _____ numbered game.

The set score is 5 - 2. The number of games played is _____ .
Do the players change sides of the net? _____

If the set score is 6 - 4, the total number of games played is _____ .
Since this is an <u>even</u> number, the players DO NOT CHANGE sides of the net.

When the total number of games played in a set is <u>even</u>, the players change sides of the net AFTER the FIRST GAME of the <u>next set</u>.

Whenever the total number of games played in a set is o_____, the players change _____ of the n_____ .

147

odd

---

seven

yes

---

ten

---

set

---

odd

sides

net

Chapter V Doubles Game: Serving and Receiving Orders

The serving order for a doubles game remains the same throughout the set.

The s _ _ _ _ _ _ _ is alternated between the right and _____

service c_____ after each p _ _ _ _ _ .

ALTERNATING of service is continued throughout the g _ _ _ _ .

Receiving and s_____ orders are decided in_____ly

of each other when playing doubles.

Partners A and B decided that A would receive the first serve of each

EVEN numbered game.

Player C is serving the second game and would first serve to Player _____ .

When the receiving order is changed during a game, the partners will resume

the original receiving order at the end of the g_____ .

A fault served before the discovery of a serving order mistake shall count.

---

serve

left

courts

point

game

serving

independently

A

game

The partner of the player who serves the first game will serve the t _ _ _ d game.

In doubles, the players on the serving team must change s_____ of the c_____ after each point.

Look at Panel 2 (GREEN)

Player A served the first game.

Player _____ will serve the THIRD game.

Player D does not have to serve the second game.

Player D is serving the fourth game; she would first serve to Player _____ .

When a mistake is made in the receiving order, the partners will resume the original r_____ order at the end of the g _ _ _ .

A f _ _ _ _ made before a serve order mistake is discovered shall c _ _ _ _ .

151

third

---

sides

court

B

A

---

receiving

game

---

fault

count

Players A and B are partners.

Player A served the first game.

Player B will serve the _____ game.

In a doubles game the serving team changes sides of the court after each p_____ .

Player C will serve the first serve of the game into the r_____ service _____ .

Player D is in proper position to serve but he does NOT have to _____ first.

The order of s_____ and r_____ is decided at the beginning of each SET.

When the r_____ order is changed, it remains as altered until the end of the g_____ and then the original r_____ order is resumed.

Player C hit the first serve of the game into the net. It was then discovered that her partner should be serving.

The correct server now has _____ chance(s) to make the service good.

153

third

---

point

---

right

court

---

serve

---

serving

receiving

---

receiving

game

receiving

---

one

The opposing team serves the second and f _ _ _ _ _ games.

In doubles the RECEIVING team does not change sides of the court after each point.

Since the RECEIVING team does not change sides of the c_____ , Player B will serve the first service of the third game to Player _____ .

The serving and receiving orders are determined _____ of each other.

The receiving and _____ orders are decided at the beginning of each _____ .

If a partner serves out of turn, his partner will serve as soon as the mistake is discovered.

If a game is completed before the discovery of a serving order mistake, the order of service remains as ALTERED.

155

fourth

court

D

independently

serving

set

Players C and D are partners. Player C served game four.

Player D served game _____ .

The receiving partners receive the serve ALTERNATELY throughout each g_ _ _ _ .

Player D receives the first s_____ of every game served by the opponents.

Player C decides to serve the second game.

Who will serve the fourth game? _____

Both receiving and serving orders remain the SAME throughout the s_____ .

If a partner serves out of t_____ , his partner will s_____ as soon as the mistake is discovered.

If a g_____ is completed before the discovery of a serving order mistake, the order of s_____ remains as altered.

157

two

---

game

---

serve

---

player D

---

set

---

turn

serve

---

game

service

Examine Panel s (GREEN). Refer to it when necessary to answer the following questions. 158

Player A served the first game.

Player _____ will serve the third game.

Player A is serving the first game of the set.

She serves the first point to Player _____ .

Since Partners A and B serve the ODD numbered games, Player D receives the first service of every _____ numbered g _ _ _ _ in the set.

Player C must hit the first serve of the game into the _____ service court.

If the order of receiving the serve is changed during a game, it will remain as ALTERED until the end of the game.

Any points scored BEFORE the discovery of a serving order mistake shall count.

When a mistake in the serving order is not discovered until the end of the g_____ , the order of service shall remain as _____ .

159

B

D

odd

game

right

game

altered

As we stated previously, the first serve of each game must go into the r _ _ _ _ _ s_____ c_____ .

Player A changes sides of the court with Player _____ and serves the next point to Player _____ .

Partners C and D will serve the EVEN numbered games.
They must decide who will serve the s_____ game and who will serve the f _ _ _ _ _ _ game.

Player C will have to change s_____ of the c_____ with Player _____ to serve into the right service court.

If the r_____ order is changed during a game, it will remain as altered until the end of the _____ .

Any p_____ made before the serving order mistake is discovered shall c_____ .

Player C served an entire game before it was discovered that her partner was supposed to serve.

What happens to the serving order now? _____

161

right

service court

B

C

---

second

fourth

---

sides

court

D

---

receiving

game

---

points

court

---

it remains as altered;

Look at Panel 2 (GREEN)

In order to serve into the right serving court, Player B must change SIDES of the COURT with her partner, Player _____ .

Player A would serve the third point to Player _____ .

The serving and receiving orders in doubles are decided INDEPENDENTLY of each other.

We have stated that the serving and receiving orders are decided in_____ly of each other.

When the receiving order is changed during a game, it remains as a_____ until the end of the _____ .

Players A and B are partners. Player B is serving and the score is 30-15. It is then discovered that Player A should be serving.

Does Player A finish serving the game? _____

Does the score remain 30-15? _____

163

A

D

---

independently

---

altered

game

---

yes

yes

APPENDIX I

PROGRAM ERRORS OF A SUBJECT WHO USED THE ORDERED SEQUENCE

PAGE	FRAME	RESPONSE	RATIONALE
45	1	"zero" instead of "love"	"Carelessness"
57	3	"C" instead of "D"	"Carelessness"
59	1	"Six" instead of "two"	"I didn't think of the second game"
55	7	"two" instead of "one"	

Pre-test score 10
Post-test score 41
Error rate 4
Time taken 52 minutes

APPENDIX J

PROGRAM ERRORS OF A SUBJECT WHO USED THE SCRAMBLED SEQUENCE

PAGE	FRAME	RESPONSE	RATIONALE
3	7	labeled forecourt instead of service courts	"confused about which way courts were labeled"
9	3	"yes" instead of "no"	"didn't know"
9	4	"foul" instead of "fault"	"didn't know term to use"
11	4	"not" instead of "improperly"	"wrong word"
11	7	"returner" instead of "receiver"	"didn't know"
15	3	"left" and "right instead of "overhand" and underhand"	"didn't know"
27	3	"first" instead of "advantage"	"didn't know what to put here"
31	6		"didn't know"
33	6	"four" instead of "five"	"didn't know"
35	1	"forty-five" instead of "game"	"didn't know the term"
51	4		"didn't know"
57	3	"C" instead of "D"	"confused as to who was standing where"
63	5	"set" instead of "game"	"automatic response"

Pre-test score 27
Post-test score 41
Error rate 20
Time taken 72 minutes

APPENDIX K

POST-TEST ERROR RATE INDICATING AREAS FOR PROGRAM REVISION

(Rank order of items missed twenty or more times)

ITEM		AREA	TIMES MISSED
Section	Number		
IV	1	Serving Rules	42
II	12	Doubles Game	42
II	3	Serving Rules	38
IV	5	Doubles Game	33
IV	8	Doubles Game	32
III	15	Doubles Game	26
II	6	Serving Rules	24
IV	4	Serving Rules	23

APPENDIX L

EVALUATION COMMENTS

COMMENT	NUMBER COMMENTING	PER CENT OF TOTAL GROUP
Programed Learning Favorable	46	74
Programed Learning Unfavorable	10	16
Programed Learning Effective	48	77
Better than Traditional Method	8	13
Disliked Page Turning	4	7

N = 62

COMMENT	NUMBER COMMENTING	PER CENT OF TOTAL GROUP
Ordered Sequence		
Did Not Like Repetition	3	10
Program too Elementary	4	13
Scrambled Sequence		
Confused by sequence	11	35
Did Like Repetition	4	13

N = 31

APPENDIX M

MATCHED PAIR SELECTION

SCRAMBLED SEQUENCE	PRE-TEST	ORDERED SEQUENCE	PRE-TEST	PAIR
Subject	Score	Subject	Score	Number
1	5	2	5	1
3	7	4	7	2
5	8	6	8	3
7	8	8	8	4
9	8	10	9	5
11	10	12	10	6
13	11	14	11	7
15	11	16	12	8
17	13	18	12	9
19	15	20	15	10
21	18	22	16	11
23	17	24	17	12
25	18	26	18	13
27	18	28	18	14
29	19	30	19	15
31	22	32	21	16
33	21	34	21	17
35	24	36	24	18
37	25	38	25	19
39	27	40	26	20
41	26	42	26	21
43	27	44	27	22
45	29	46	28	23
47	30	48	30	24
49	13	50	13	25
51	22	52	23	26
53	21	54	21	27
55	36	56	33	28
57	27	58	30	29
59	4	60	7	30
61	10	62	10	31
T* 31	550	31	550	31

* T = totals

APPENDIX N

RAW DATA

SUBJECT	PRE-TEST	POST-TEST	IMPROVEMENT	PROGRAM ERRORS	PROGRAM TIME
Scrambled Sequence					
1	5	37	32	6	66
3	7	36	29	12	68
5	8	37	29	31	101
7	8	38	30	18	78
9	8	35	27	24	93
11	10	39	29	21	83
13	14	37	23	18	102
15	9	35	26	11	106
17	10	38	28	20	82
19	15	38	23	29	79
21	18	35	17	14	71
23	17	39	22	23	58
25	18	38	20	24	80
27	18	41	23	13	105
29	19	33	14	7	70
31	22	41	19	14	80
33	21	40	19	6	86
35	24	44	20	3	84
37	25	38	13	21	54
39	27	38	11	15	53
41	26	39	13	28	92
43	27	41	14	20	72
45	29	40	11	16	60
47	30	34	4	18	92
49	13	36	23	31	64
51	22	40	18	11	110
53	21	39	18	19	82
55	36	37	1	2	45
57	27	37	10	31	80
59	4	36	32	7	62
61	10	36	26	23	93

APPENDIX N (continued)

SUBJECT	PRE-TEST	POST-TEST	IMPROVEMENT	PROGRAM ERRORS	PROGRAM TIME
Ordered Sequence					
2	5	36	31	6	71
4	7	37	30	3	47
6	8	39	31	1	60
8	8	34	26	7	83
10	9	34	25	2	70
12	10	41	31	4	52
14	11	36	25	1	78
16	12	40	28	0	69
18	12	41	29	5	52
20	15	38	23	13	65
22	16	33	17	0	60
24	17	43	26	0	66
26	18	39	21	9	62
28	18	35	17	1	68
30	19	38	19	9	73
32	21	36	15	2	73
34	21	42	21	1	75
36	24	33	9	2	71
38	25	40	15	1	67
40	26	39	13	6	55
42	26	36	10	4	65
44	27	41	14	2	51
46	28	41	13	1	87
48	30	40	10	6	52
50	13	37	24	10	80
52	23	40	17	1	55
54	21	37	16	1	84
56	33	36	3	0	58
58	30	31	1	0	122
60	7	38	31	8	87
62	10	32	22	0	74